WHOI-98-16

Woods Hole Oceanographic Institution

Coastal Landform Management in Massachusetts:

Proceedings of a Workshop held at the Woods Hole Oceanographic Institution, Woods Hole, MA USA October 9-10, 1997

Edited by

Tracey I. Crago and Sheri D. DeRosa

August 1998

Technical Report

Approved for public release; distribution unlimited.

Sponsored by the Sea Grant Program
of the Woods Hole Oceanographic Institution

Co-sponsored by Massachusetts Coastal Zone Management, Cape Cod Commission,
and Massachusetts Institute of Technology Sea Grant College Program

WHOI-98-16
WHOI-W-97-001

Coastal Landform Management in Massachusetts: Proceedings of a Workshop held at the Woods Hole Oceanographic Institution, Woods Hole, MA USA October 9-10, 1997

by

Tracey I. Crago and Sheri D. DeRosa

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

August 1998

Technical Report

Sea Grant
Woods Hole

Sponsored by the Sea Grant Program of the Woods Hole Oceanographic Institution and co-sponsored by Massachusetts Coastal Zone Management, Cape Cod Commission and Massachusetts Institute of Technology Sea Grant College Program

Approved for Distribution:

Judith C. McDowell

Judith McDowell
Director, Woods Hole Oceanographic Institution Sea Grant Program

Acknowledgments

Workshop sponsors thank the members of the workshop planning committee—many of whom also served as speakers or facilitators—for their countless hours of advice and assistance planning and executing the workshop:

- Tracey Crago, WHOI Sea Grant Program
- Sheri DeRosa, WHOI Sea Grant Program
- Julie Early, Cape Cod Commission *(presently with the Island Foundation)*
- Graham Giese, WHOI Sea Grant Program
- Truman Henson, Massachusetts Coastal Zone Management
- Dale Leavitt, WHOI Sea Grant Program
- Jim O'Connell, Massachusetts Coastal Zone Management *(presently with the Cape Cod Commission)*
- Judy Pederson, MIT Sea Grant College Program

Additional individuals who contributed a significant amount of time and energy to the success of the workshop include the following speakers:

- Sandy Macfarlane, Town of Orleans Conservation Commission
- Mike Reynolds, Cape Cod National Seashore
- Jay Tanski, New York Sea Grant Institute

Transcripts were prepared by Maureen Pires, Verbatim Court Reporter, and provided to WHOI Sea Grant for editing. Tim Silva and Jack Cook, WHOI Graphic Services Department, provided uninterrupted audio/visual services throughout the workshop.

Funding for these proceedings was provided by the sponsoring organizations, including the NOAA National Sea Grant College Program Office, Department of Commerce, under NOAA Grant Nos. NA46RG0470 and NA86RG0075, Woods Hole Oceanographic Institution Sea Grant Project No. M/O-2. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

Table of Contents

Abstract

The primary objective of this publication is to share with a wider audience the information and ideas that were shared by those attending the first workshop on Coastal Landform Management in Massachusetts that was held at the Woods Hole Oceanographic Institution on October 9 and 10, 1997. The workshop was designed to benefit resource management decision-makers through interactive exercises and discussions of coastal problems ranging from those that arise everyday to those of unusual complexity. The immediate objective of the workshop was to improve familiarity with existing management methodologies. The long-term objective was to improve the methodologies themselves.

The workshop was divided into four sessions, each beginning with a presentation followed by discussion. The discussions took place in four separate "breakout groups"—each led by a facilitator—that looked critically at the presentation and prepared a response. The entire group then reconvened for a panel discussion led by the facilitators and the presenter.

The first presentation (J. O'Connell) discussed the diverse landforms of the Massachusetts coast, the processes that produce and maintain them, and the problems associated with selecting the most appropriate management techniques. The second (S. Macfarlane) focused on difficulties of managing inner shores using the Nauset and Pleasant Bay estuaries as examples. The third (J. Tanski) discussed management of altered shores using as an example Westhampton Beach on the south shore of Long Island. The final presentation (M. Reynolds and G. Giese) concerned the monitoring of changes in coastal landform sustainability and described checklists prepared to help managers monitor such changes.

Introduction

The first workshop on coastal landform management in Massachusetts was held at the Woods Hole Oceanographic Institution (WHOI) on two beautiful days in early October 1997. It was designed to offer practitioners an opportunity to explore the realities of coastal management through interactive exercises and discussion with the objective of improving our understanding and skill at using the management tools at hand, and ultimately, improving the tools themselves. By all accounts it was a successful effort—one that we would like to share with you by providing in this volume a proceedings of the workshop.

The two-day period was divided into four sessions, each beginning with a presentation followed by discussion. These discussions formed the heart of the workshop. They took place in four separate "breakout groups"—each led by a facilitator—that looked critically at the presentation and prepared a response. The entire group then reconvened for a larger discussion, led by a panel consisting of the facilitators and the presenter. The large group discussions were often lively, sometimes heated, and always productive.

In the first session, Jim O'Connell of Massachusetts Coastal Zone Management discussed the difficulties presented by our efforts to use coastal landforms without abusing them, and the dilemma posed by our wish on one hand to protect coastal properties, and on the other hand to protect the landforms that the properties occupy. Following a "tour" of the diverse landforms of the Massachusetts coast, Jim discussed the processes that produce and maintain them, and then moved on to the knotty problem of selecting the most appropriate management techniques. For the following breakout session, Jim outlined a hypothetical shoreline development proposal and challenged the other participants to develop creative solutions to the complex problems that it raised.

In her presentation, Sandy Macfarlane, Conservation Administrator of the Town of Orleans, focused the group's attention on difficulties of managing inner shores. Using the Nauset and Pleasant Bay estuaries as examples, she emphasized the significance of wildlife habitats within these systems. She led us through the development of a resource-based management plan for Pleasant Bay that led to the development of a semi-quantitative matrix evaluating dock and pier siting. Sandy concluded by presenting the matrix to the group for breakout-session discussion.

Jay Tanski of the New York Sea Grant Institute discussed the management of altered shores for the workshop's third presentation. Providing an example of what Massachusetts may have to face someday, Jay began by providing a tour of the south shore of Long Island from Montauk Point to New York City, from residential to urban development. Then he turned to the saga of a specific community, Westhampton Beach, that by the late 1980's—following decades of mismanagement—faced a severe threat of property loss on a major scale. He then asked the

group to develop management strategies for the 1990's—only to later tell us what strategies were actually developed and how they fared.

The final presentation, a joint effort by Mike Reynolds of the Cape Cod National Seashore (CCNS) and Graham Giese of the WHOI Sea Grant Program, concerned the monitoring of changes in coastal landform sustainability. Mike began by reviewing the relatively undisturbed coastal systems within CCNS and the management challenges that have arisen, concluding that good science and good monitoring can lead to improved decision-making. Graham followed with a discussion of checklists prepared for the use of management decision-makers to estimate the likely effects of proposed projects on the sustainability of coastal landform systems. He ended by presenting them to the group to apply in the breakout session to five selected "real-life" projects.

Our primary objective in preparing these proceedings is to share with a wider audience the information and ideas that were shared by those attending the workshop. There are no final answers here, but there is a lot to think about. We invite you to join with us in our on-going discussion of how we can improve our efforts to encourage the "use without abuse" of our precious coastal landform systems.

Thursday, October 9, 1997
Welcome

DR. McDOWELL: I'm Judy McDowell. I'm the Director of the Woods Hole Oceanographic Institution (WHOI) Sea Grant Program, and I'd like to welcome you to the workshop on Coastal Landform Management in Massachusetts.

The sustainability of coastal landforms is an issue that not only faces us in Massachusetts but coastal areas throughout the world as we deal with both the changes in natural processes with sea level rise, and the continuing stress that human population puts on coastal ecosystems in terms of increased construction, increased development, increased population pressures. So I think the issues that you have before you over the next two days to look at problems and solutions to maintaining coastal landforms in Massachusetts have very important implications for our local areas, but they can also be used as examples for other areas of the world where the same problems are being faced.

The weather is going to cooperate. It's going to be a beautiful two days, I hope. That will only give you inspiration to continue to work so hard within these rooms.

If you have any questions about logistics, Tracey Crago from WHOI Sea Grant, and Sheri DeRosa from WHOI Sea Grant, can assist you in any way, if you need to make phone calls or faxes, et cetera. And without further ado, I'll introduce Armando Carbonell, the Executive Director of the Cape Cod Commission, to offer his welcoming remarks. Armando?

MR. CARBONELL: Thanks, Judy. Good morning. It's a pleasure to be here. I hope the sun does come out. We've had absolutely gorgeous fall weather for the last few days. Perfect Cape Cod. And I think it is appropriate that you are here to talk about this subject.

I would like to say a few words about Cape Cod, say a few words about your subject if I may, and then tell you a little bit about the new regional policy plan, which just came back from the printers yesterday, and which I will formally transmit to Peg, in her official capacity, as soon as she gets here, because there is a connection between Massachusetts Coastal Zone Management and the Cape Cod Commission when it comes to this regional plan that I'll mention a little later on.

Coastal Landform Management. I see some tension between the title of that program here and some of the content that I anticipate when I see words like "sustainability" later on in the day. And I want to encourage you to embrace that tension and see where it takes you. I think of coastal processes as dynamic. I'm not sure I can understand them as being sustainable in a normal sense, although I think one can sustain their dynamicism by essentially letting them do their work. And I think that is largely what we have learned about coastal processes and coastal landforms: that they're about change, they're about all sorts of risk and danger to human beings, and the best approach that we can adopt is one of letting them be.

Learning how to do that, in a place where we have been living so close to the power of the coast is going to be a great challenge. Cape Cod is one of the most dynamic places in the northeast. We've had an awful lot of experience, good and bad, dealing with coastal processes and trying to intervene in natural systems. I certainly hope that you will indulge in some creative resolution of the tension between these two concepts, that of sustainability and that of management. I suspect we're talking a lot more about managing human beings than about managing coastal landforms in the end.

I'm sorry I won't be with you throughout the program, other responsibilities call me. I will look forward to a report on where this all comes out.

Our regional plan, as I mentioned a second ago, deals with these issues in a section that is symbolized by this graphic of dune grass and waves and a bit of -- it looks like sediment of some kind, little triangles. There are a number of key ingredients to this set of policies on coastal processes, and I have singled out just a few to describe to you, and maybe they can help you to frame some of this debate about management or dynamic sustainability.

We like to number all of our policies and recite the numbers at every occasion, so don't mind me if I read off a lot of numbers here. Perhaps we should memorize these. It reminds me of an analysis I once read of the Marquis de Sade's, A Hundred Twenty Days of Sodom, but I probably shouldn't go into that here.

2.2.2.1, no development or redevelopment in FEMA V Zones. These policies, I think, go beyond those that you're likely to find elsewhere. They do have lots of fine print that I'm not going to read to you, and there are people here who would be happy to go into the fine print with you. There's a lot of room here for discussion. I'm going to give them to you in black and white.

2.2.2.3, no development or redevelopment on barrier beaches and coastal dunes.

2.2.2.4, where banks or dunes are eroding, the setback for all new buildings and septic systems, has to at least be equal to the 30-year erosion history of that area. For fun, we phrased this as the average rate of erosion -- 30 times the average rate of erosion over the last 30 years. So you get to multiply and divide by 30 in order to come up with the same number. I'm giving you a hint here. Consultants in the room take no charges for that.

2.2.2.9, no new revetments or other coastal engineering structures in V Zones, where they would alter vegetative cover or interrupt the supply of sediment.

2.2.3.7, an undisturbed buffer, at least equal to 100 feet for coastal wetlands and water bodies. So now that's twice the minimum protection otherwise available in Massachusetts.

These are things that we are pursuing through our authority under the Cape Cod Commission Act here on the Cape. They represent one of the significant sections of the regional plan. Peg hasn't quite made it back in time to just grab the microphone from me, so I'm sure she'll be catching up with you later on. One of the things that the Cape Cod Commission Act said when it was adopted is that -- Here she is. This is terrific timing.

Peg, I'm speaking about you because you're going to take the microphone momentarily, and I'm going to hand you the recently-adopted Regional Policy Plan for Cape Cod as an official transmission of a document which, according to our statute, needs to be presented to Coastal Zone Management for their consideration for adoption into the policies of the state coastal zone management program, which we believe should lead not only to consistency in the review of state projects in Massachusetts with these policies and goals but also federally funded projects on Cape Cod. So we think it's an important document and important process.

I hope you enjoy your two days here. I hope they're productive. I hope you come to a resolution of the conflict that I described. I'll turn it over to Peg. Thank you very much.

MS. BRADY: Good morning. Sorry, I was running a little late. The traffic in Boston was a bit more than I could handle from day one back in the office after being on vacation.

I was very intrigued by some of the coastal armament that I discovered over the way, some of the structures that people have put up along the eastern shoreline of the coast of England. And I was very intrigued by some of the issues that they're dealing with over there. Some of the issues and discussions I was listening to. I felt I was back in Boston. So this surely is a global village, and particularly an issue of managing our coast and moving -- the moving coast, so to speak.

I just want to thank the Woods Hole Sea Grant and the Cape Cod Commission and, obviously, Jim O'Connell, from my office, who were the instigators, and I think this is actually a wonderful program. We're hopefully going to pick people's brains and ideas, get some great ideas about how do we manage the coast now that we have an abundance of information before us.

Obviously, we've had 20 years of coastal zone management. Next year will be our twentieth anniversary for the State of Massachusetts in coastal zone management. We've come a long, long way. We have an extraordinary State Wetlands Act, extraordinary in the sense that it's extraordinary when you compare what other states are doing with regard to managing the coast. And it has, I think, stood the test of time when you look at the many challenges that have gone on over the last 15, 20-some-odd years with regard to managing the coast.

I'm looking forward to the results and some of the outcomes. It's clearly going to help Jim, and Rebecca who's also a member of our office that helps in technical assistance, and also help many of the DEP (Department of Environmental Protection) staff that are out there dealing with this issue day in and day out, the wetlands staff.

I just want to touch on a couple of things, do a little bit of a commercial break here for Coastal Zone Management. As many of you know, if you read our newsletter, we've done -- we last year successfully were reauthorized nationally, but we're faced with actually a good and a bad thing that happened to us this year nationally in Coastal Zone Management. We successfully were level-funded last year in Coastal Zone Management nationally, and that was good when you look back on the 104th Congress. The unfortunate thing, good and bad, two new

states came into the program. And with being level-funded and with also two new states coming into the program, we were faced with smaller pie slices that went to the states. And we're feeling that this year in our office as are some of the other states nationally. So, we're looking at belt-tightening this year, unfortunately. And, as we speak, the Senate and the House Conference Committee is debating our budget, and we are looking at some very, very good numbers, but we just don't know what the outcome of that conference committee debate will be. It's unfortunate that there are no members of our congressional delegation in any of those deliberations, but they have heard from me, and they have been traditionally very, very strong supporters of Coastal Zone Management.

I just wanted to alert you folks, if you are talking to any of your colleagues in other states and have a way to communicate to some of the other members of congress that are in a position of talking about the Coastal Zone Management budget and appropriations coming up, what that means.

As I look around the room, I see a lot of close colleagues of our staff. They know exactly what the staff have produced this year. We just delivered the shoreline change maps, thanks to the leadership under Jim O'Connell, and we've also delivered about eight workshops across the coast in explaining how those shoreline change maps can better affect future development in the coastal zone as well as help in decision-making, planning decisions that are going on in the 78 coastal communities.

So you can see the true benefit of a program that is, comparatively speaking, a small budget item nationally. We do deliver. We do deliver in terms of technical assistance, staff time, Jim and Rebecca and our regional coordinators Dave Janik here and Truman down here in the Cape region. And those folks always stand ready to help the local communities.

But again, I just wanted to do that quick commercial break because it is an important issue for Massachusetts and for my colleagues across the country.

I will talk to Armando about this document that he just hand-delivered to me. I do want to thank you, and I hope that the next two days are very productive, and I hope to listen in on part of it today. I'm sorry I can't be here tomorrow, but I look forward to the outcome.

And thank you, Graham, for hosting this and to your staff as well. Thank you.

Workshop Objectives

DR. GIESE: Thank you, Peg, very much. And thank you, Judy and Armando. Thanks to your organizations, too, especially to members of the planning group who worked so hard to pull this meeting together. And thanks to all of you who are here today, who have given up two full days of your time -- and we all know what that means these days -- to come to this meeting. Many of your faces I recognize, but there are also new faces, too, and I'm happy to see you all.

I have asked myself why us? Why are we all here together? Of course, all of us care about coastal landforms; we like beaches and dunes and marshes. We are drawn to them emotionally and intellectually. But that's not why we're here. This isn't a preaching-to-the-choir kind of exercise. The reason we're all here is because we work with coastal landforms and our work is getting more difficult all the time. Why is that? Why is our work getting more difficult?

Well, it's getting more difficult because of a single coastal process, and that coastal process is human activity much along the lines that Armando introduced previously. I asked myself this morning what would Aristotle have said if he, with no previous preparation, had heard about our workshop? I expect he'd have said, why manage coastal landforms? Harbors, yes, of course, but why beaches, why bluffs, dunes, and marshes? They are well managed already. They're managed by waves and tides and wind.

But we know all too well that today the factor dominating many coastal regions is human activity, and that few regions, indeed, are not affected in some way by such projects. Because of the vast scale and increasing pace of our human interaction with natural coastal systems, our need for knowledge is growing faster than our supply of knowledge.

It is our hope that by working together as a group for these two days each of us will be better able to obtain and to supply the information that we all need to better manage the coastal landforms of Massachusetts.

Let me go over some housekeeping items. When we registered we all received a name tag such as this, and underneath our names are some interesting things. There are a couple of free drink tickets for the reception this afternoon. Beer, wine, soda and juice will be available. And also there are tickets for the lunches, and Tracey and Sheri -- who I can't thank enough -- will take the tickets from you when you pick up your lunches.

Each of your badges has a colored sticker on it, and that colored sticker designates the particular breakout group that you've been assigned to. Green and red groups will be here in this room, at opposite ends of it, with Truman Henson and Julie Early. Those with yellow will be meeting with Judy Pederson in the small room just across the hall -- there's a little sign out front. And those with a blue sticker will be meeting with Dale Leavitt downstairs on the first floor of Clark, in room number 201, also known as the Fuglister Room.

The proceedings of the workshop will be available in the winter, and to help us with that, Maureen Pires is here. She would like it very much if, when we speak, we use the microphones which are on opposite sides of the room, and, of course, there is one here. Also she'd like it if we would identify ourselves when we're asking a question or making a comment.

Let's see... reviewing the agenda which we all picked up when we came in... there's tea, coffee, and juice outside now, whenever we want them. All day long they will be available, today and tomorrow. Lunch is at 12:30, and -- an important point -- the reception with hors d'oeuvres and drinks at 4:00. Then tomorrow morning, coffee, tea, muffins. and juice -- so you don't have to stay home for breakfast -- at 7:30; and then lunch at 12:45.

I hope as many of you as possible will try to stay over tomorrow afternoon for our discussion. Let me point out that downstairs on the floor below the ground floor -- it's actually Clark 1 -- there's a pay telephone next to the vending machine. Bathrooms are right across the hall here, and, of course, water's there. That seems to be all that I have on those things.

The important part of our agenda, of course, are the activities that we will all participate in. As you can see, the two-day period is broken up into four different sessions, each of which will be led by a presenter.

Then we'll break up into those four groups that I mentioned, as designated by our badges. Those breakout groups will work with materials relating to the presentation. After that, we will join together again here in this room. The facilitators and recorders from your workgroups will form a panel with the presenter, and they'll present the questions and ideas, problems and inspirations that came up in their groups. That panel discussion will be led by the presenter.

There are four topics. We're going to begin now at 10:15 with the first, which will be presented by Jim O'Connell, the Massachusetts Coastal Zone Management Coastal Geologist and Coastal Hazard Coordinator. Jim.

Shoreline Change: Coastal Landform Management Dilemma
Jim O'Connell, Massachusetts Coastal Zone Management

MR. O'CONNELL: The erosion and flooding caused by storms and relative sea level rise are not only natural physical coastal processes, but they are essential processes. Without erosion, flooding, storms, and relative sea level rise, we wouldn't have the beaches, dunes, barrier beaches, and productive tidal flats, salt marshes, and, in many cases, bays and estuaries that owe their existence to the presence of dunes, beaches, and, particularly, barrier beaches that we see as we walk along the shoreline today.

On the other hand, the Massachusetts shore, for the most part, is developed. People have a right to protect and enjoy their property, provided that the protection techniques they use do not adversely impact adjacent or downdrift properties or diminish the beneficial functions of other coastal landforms in the system. Diminishing the beneficial functions provided by coastal landforms, such as storm damage prevention and flood control, could result in adverse impacts to other shoreline properties and resources.

In this presentation I will be outlining a variety of coastal landform management techniques. In order to select appropriate coastal landform or coastal management techniques, however, one must first have a basic, fundamental, qualitative understanding of how the shoreline functions. That is, the complex interaction between winds, waves, tides, and longshore currents that create physical coastal processes. These processes, in turn, shape and reshape our shoreline. In addition, it's extremely helpful to have full knowledge of the many and diverse proactive and reactive techniques that are available to protect and manage coastal landforms.

So, briefly presented will be a qualitative discussion with accompanying slides that depict how this complex interaction between waves, tides, storms, flooding, longshore transport, and relative sea level rise work together to shape and re-shape our shoreline. In addition, a wide variety of management techniques, both proactive and reactive, that are available to us today to manage these coastal landforms will be described.

This presentation on the complex interaction of physical coastal processes and resulting coastal landform changes, along with a description of landform management practices will prepare you to participate in a very creative exercise in reviewing a multi-faceted development proposal along the shoreline. The goal of this exercise is to apply some of these management techniques, and determine whether or not they work to meet shoreline management objectives.

But before we delve into the world of physical coastal processes, lets take a tour and explore the spectacular beauty of the many diverse landforms that we see as we walk along the shoreline of Massachusetts today.

Massachusetts has approximately 1,500 miles of ocean-facing and tidal shore, with an extremely varied geographic orientation to our shoreline (see Figure 1). Because of this extremely varied geographic orientation, no portion of the Massachusetts shore escapes some degree of

flooding, erosion, or storm damage during specific wind and wave conditions around the entire compass rose. In addition, Massachusetts has varying tidal ranges from the nine to twelve foot tidal range of Cape Cod Bay, to the two to four foot tidal ranges in Buzzards Bay and the southern shore of Cape Cod, to the shorelines of Nantucket and Martha's Vineyard which generally exhibit a two to four foot tidal range.

Massachusetts has undoubtedly one of the most diverse suites of spectacularly sculptured coastal landforms of any state in the nation. For example, the Gay Head Cliffs in Martha's Vineyard. The cliffs were formed by a succession of repeated glaciation and inter-glacial processes, as were most of the coastal landforms we view today. Next we see the spectacular cliffs or coastal bluffs along the eastern shore of Nantucket, again formed as a result of repeated glaciation and inter-glacial processes. Martha's Vineyard and Nantucket consist mainly of coastal plain deposits capped by outwash and moraine deposits of the Wisconsin glaciation.

Moving over to the west shore of Cape Cod Bay are the spectacular eroding interlobate moraine and outwash plain deposits forming 100+ foot high bluffs located along the shores of southern Plymouth. These formed between the Buzzards Bay and Cape Cod Bay ice lobes. Along the easternmost shores of Massachusetts is the Cape Cod National Seashore which is also a remnant part of an eroded interlobate moraine and outwash plain formed between the South Channel and Cape Cod Bay ice lobes that existed approximately 15,000 to 18,000 years ago.

This landform, the extensive bluffs comprising the Cape Cod National Seashore, existed between approximately three to four miles seaward than you presently see today relative to when the last continental glaciers began to melt some 15,000 to 18,000 years ago.

Massachusetts coastal areas also have a series of fluvio-glacial deposits (laid down by the meltwater from the glaciers), such as the outwash plains we see on the southern side of Cape Cod and the southern side of the islands of Martha's Vineyard and Nantucket. In addition, eskers and kame deposits exist in Massachusetts coastal areas, such as we see on the eastern shore of Cape Cod Bay in the Town of Wellfleet. As can be seen here, erosion of these deposits provide massive volumes of sediment, in this case principally sand, into a littoral zone feeding downdrift beaches, dunes, barrier beaches, and tidal flats.

Under the ice sheets, back 15,000 to 18,000 years ago, thousands of drumlins were formed. These landforms are beautiful whaleback-shaped formations, such as we see in Ipswich on the North Shore or Gurnet Point at the southern terminus of Duxbury Beach in the Town of Plymouth. As with the Cape Cod National Seashore, we again can see that this drumlin landform at Gurnet Point also existed a considerable distance seaward when it was first deposited. This is evidenced by the boulder platform fronting the Gurnet Point drumlin. Massachusetts also has an extensive array of bedrock outcrops, primarily on the North Shore, but they are also exposed along the South Shore and Buzzards Bay areas as well.

At the end of the last glacial (Wisconsin) maximum, sea level was approximately 200-300 feet lower than it is today. When sea level began to rise 15,000 to 18,000 years ago, many of these landforms that contained unconsolidated materials began to erode and began providing massive amounts of sediment into the littoral zone. Many of the landforms created by past glacial episodes, particularly those that were deposited on what is now the continental shelf, no longer exist due to erosion resulting from relative sea level rise.

As a result of the material provided due to erosion of former glacial landforms, and the continuing erosion of coastal landforms that we see today, 681 barrier beaches were formed in Massachusetts. Many of these barrier beaches are comprised mainly of sandy deposits, such as we see here at Nauset Beach in Chatham and Orleans. However, many barrier beaches that we see today in Massachusetts also consist of cobble deposits. These cobble deposits are also regulated as dunes under the Wetlands Protection Regulations because they provide similar functions as sand dunes, such as storm damage prevention and flood control, although they react and transport somewhat differently under storm wave conditions.

All of these coastal landforms contain a varying degree of development. This slide shows a cobble storm deposit/dune in the early 1900s. This is Humarock Beach on the South Shore in the Town of Scituate. In contrast, this slide shows the development which has taken place on this cobble/sandy barrier during this century.

Salisbury Beach, in the Town of Salisbury, is our northern-most community. Here we see the density of development on Salisbury Beach. This slide shows what Salisbury Beach looked like after the Blizzard of 1978, a 100-year storm and Presidential declaration of disaster. The beach has somewhat recovered, and there is a small sand dune fronting many of the exiting structures.

Moving south, we have the beautiful barrier beaches of Plum Island and Castle Neck, which are primarily undeveloped and protected due to its ownership. But as we move further southward along the North Shore, much of the coast is heavily developed. Even some of bedrock outcrops, as we see in the Rockport and Gloucester areas, have been developed.

As we continue southward, we arrive in the more urban areas of Winthrop/Revere that have densely developed populations along the shore. This is the City of Boston. One of the many issues to be explored at this workshop is: should we manage heavily developed and/or armored shores similarly to sparsely developed or pristine shores?

Continuing south of Boston beyond the Boston Harbor/Quincy-Hingham Bay systems, we reach Nantasket Beach in the Town of Hull, a heavily developed barrier beach. Classic drumlins appear in the background, creating the islands of Hingham and Quincy Bays.

Southward we reach the Town of Scituate, whose shoreline and coastal landforms were in many areas armored with sea walls beginning in the 1930s and 1940s. Due in part to that armoring, dense development was encouraged. The consequences of densely developing a high energy shoreline is something we are all aware of.

The next town south of Scituate is the Town of Marshfield. As with Scituate, for the most part about 80 percent of the Marshfield shoreline is armored both with vertical seawalls and revetments.

Farther south we move along the Cape Cod Bay shoreline of the Town of Plymouth. It has some of the most beautiful cliffs or coastal bluffs that we see in Massachusetts. Some of these bluffs are vegetated, resulting in slower erosion rates than those that are unvegetated. Varying degrees of development exist along the top of these bluffs.

Continuing to move along the Cape Cod Bay shoreline, we see the shoreline of the Town of Dennis. We again see mixed density of development along these eroding bluffs. Only a few vacant lots presently exist atop these bluffs.

Hooking around Provincetown, this slide shows an aerial view of the spectacular eroding bluffs of the Cape Cod National Seashore. Moving southward along this eastern shore, we see the configuration of the inner shoreline of Chatham before the infamous 'breach' in the Nauset barrier beach in 1987. Again, this figure leads to another question we hope to address at this workshop: should we be managing inner shorelines similarly to outer high energy shorelines? The coastal processes operating on the inner shorelines are identical to those of the outer shore, the difference being in intensity and frequency of coastal processes.

The south side of Cape Cod is heavily developed, protected by almost a continuum of seawalls, revetments, and groins. There are some areas along the south shore of Cape Cod that are undeveloped, but for the most part undeveloped areas are few and sandwiched between developed areas.

Crossing Nantucket Sound are the islands of Martha's Vineyard and Nantucket, and the Elizabeth Islands. Much of the south shore of Nantucket is undeveloped, however, there are some serious problems where development is occurring. Other than migrating barrier beaches, the highest long-term average annual erosion rates in Massachusetts occur along the south shore of Nantucket, exhibiting upwards of 12 feet per year on average, based on 140 years of data.

The north side of Nantucket is more densely developed than the south shore. Erosion on the north side is not near as severe as the south side. However, the erosion rate is not necessarily the sole criteria to identify an area as a hazardous coastal area. In combination with the erosion rate, the density and proximity of development to the high water line and wave inundation areas (Velocity zones) are considerations in identifying hazardous coastal areas.

Sandwiched in between the densely developed shores of Massachusetts are some spectacular landforms which are, for the most part, responding naturally to physically coastal processes. For example, this slide shows Duxbury Beach, a barrier beach. Note the concave configuration in the northernmost section of the Duxbury Barrier Beach. This concave area in the barrier beach has actually migrated landward, maintaining its total width, approximately 140 feet over the last 140 years.

This slide shows another beautiful barrier beach, Rexhame Beach, in the Town of Marshfield. As with Duxbury and Plymouth Long Beach, Rexhame Beach is an undeveloped (or sparsely developed) barrier beach and is, therefore, one of 96 designated Coastal Barrier Resource Act (CBRA) Units in Massachusetts. Here is Sandwich Town Beach on the Cape Cod Bay shoreline of the Town of Sandwich, another CBRA Unit. A major dune nourishment project utilizing dredged material has taken place on this barrier beach, and you can see the differences between the natural dunes and the artificially created dunes.

Landform management techniques.

By now we have gained an appreciation for the incredible diversity of coastal landforms and the varying degrees of development and pristine areas which exists along our shores. Now, how do we select the most appropriate landform management techniques in terms of storm damage prevention, flood and erosion control, and other hazard mitigation techniques that allow us to live in harmony along our shores?

As shown in Table 1, the first criteria is to define what hazards are of interest, followed by identifying and mapping areas most susceptible to these the hazards. Understanding what causes these hazards along the shoreline is critical to selecting an appropriate management technique. We have identified storms, erosion, flooding, and relative sea level rise as the operative coastal processes to address. However, one must really define what is meant by hazard in a community or area, and then identify or map the specific areas that are most susceptible to these particular hazards. Keep in mind that erosion, flooding, and relative sea level rise are not in and of themselves hazards. It is only when immovable objects, such as dwellings and roads, are placed in the path of erosion or flooding that a hazard is created. Human activities along the shore have also been recognized as creating hazards.

Table 1

MASSACHUSETTS COMPREHENSIVE COASTAL HAZARDS REDUCTION STRATEGY

Plan of Action

1. Define coastal high hazard areas;
2. Identify/map specific areas most susceptible to these hazards;
3. Identify existing mechanisms (regulatory, executive order, policy, etc.) which contribute to meeting the objective and to what extent;
4. Develop and enhance programs to avoid identified hazards or mitigate their effects.

Importantly, in order to select the most appropriate management technique, and again each management technique is very site or area specific, one must have a basic, qualitative understanding of physical coastal processes.

One of the major coastal processes that must be considered is alongshore sediment transport, or littoral transport, which is created by waves. Waves very rarely hit the shoreline perpendicular or straight on. They almost always approach the shoreline at some angle. And when they hit the shoreline at an angle, they set up a momentum of water moving in the same direction that the wind and the waves are moving.

For example, in this slide (see Figure 2) the waves are hitting the shoreline at an angle, thereby creating movement of water going from the left side of the screen to the right side of the screen. That movement of water, referred to as longshore current, carries sediment such as sand and cobble along in bed load transport or suspended in the water column. This movement of material in the longshore current is called longshore sediment transport or littoral drift. So we have sand and other unconsolidated material moving along in the nearshore zone based on the direction of the wind and, thus, the waves that are created by the wind.

An example of the longshore transport process is shown here. This is again the southern shore of Plymouth, in the Nameloc Heights/Cedarville area. As shown, the high bluffs are eroding, providing large volumes of material into the longshore sediment transport system, or littoral zone, much to the chagrin of some of the property owners along the top of the eroding bluffs. Due to the predominant northeast winds in Massachusetts, one can see from this slide that the movement of eroded material from the bluffs is traveling southeast along the beaches of Cape Cod Bay past the Cape Cod Canal and continuing east towards Barnstable. That eroded material is responsible, in part, for creating the four to five mile long Sandy Neck barrier beach in the Town of Barnstable, through a process of spit accretion. This next slide shows this process of spit accretion and thus the formation of Sandy Neck. This slide shows what the Sandy Neck barrier beach looked like during its development beginning approximately 3,000 years ago. As the sand continued to erode from the Cedarville/Nameloc Heights bluffs, as well as receipt of some material from erosion of the nearshore bed, this barrier beach continued to build through spit accretion. As the barrier continued to build and elongate, it began providing protection to landward areas and created a quiescent water body. In these quieter, protected waters created by the presence of this new barrier beach, salt marsh, tidal flats, and shellfish beds began to form. The barrier beach also began to provide storm damage prevention and flood control to landward areas. These interests provided by barrier beaches and dunes are now protected under the Coastal Wetlands Protection Regulations.

This slide is an aerial photo of what the Sandy Neck barrier beach and environs look like today. Extensive salt marsh, tidal flats, and shellfish beds now exist, and the landward water body is extremely biologically productive. This photo shows a ground view of Sandy Neck today. The dunes are healthy and providing storm damage prevention and flood control to

landward areas, as well as abundant wildlife habitat, which are interests protected under the Wetlands Protection Regulations. They are also valued aesthetic and recreational resources.

A broader perspective can be gained from the satellite imagery in this slide showing the importance of longshore sediment transport. In this image, the littoral cell between the Cedarville bluffs and Sandy Neck is clear. The sand is transported southward then eastward due to the predominant northeast waves. This continuing natural process allows for the continued existence of Sandy Neck. This same longshore sediment transport (littoral drift) process was responsible for, or contributed to, forming the barrier beaches in Wellfleet, Provincetown, Nauset Beach, Monomoy, and many of the of the barriers you see along the Cape Cod Bay shoreline and the Islands as well, as we see here. So, longshore sediment transport was, and continues to be, an extremely important process in forming and elongating many of the barrier beaches and beaches that we see today.

In addition to 'longshore sediment transport,' onshore, offshore, and across-shore movement of sediment also occurs. The dotted line in this slide (see Figure 3) represents a pre-storm dune profile. During storms, waves are generally steep and have a short 'wave period.' A 'wave period' is the time it takes two successive wave crests to pass a stationary point. These wave characteristics result in beach and dune erosion. But the sand eroded from the dune and beach doesn't disappear. The sand is generally transported to the nearshore region where it creates 'storm bars' (nearshore sand bars). This storm bar in turn trips storm waves contributing to wave breaking, and thus dissipates some of the initial storm wave energy before it continues to hit the beach and dune area. So there is an 'equilibrium beach/nearshore profile' that is established during storm periods, and another established during quiescent, non-storm periods.

An example of this process is shown along Duxbury Beach. This photo was taken approximately one week after the October 1991 storm, which resulted in a presidential declaration of disaster. Note the longshore bars, or storm bars, that were formed from deposition of sands as a result of erosion of the dunes and beach. But the sand in the storm bars immediately seaward didn't come from the dune directly landward of it. The sands actually came from some property updrift and moved along that shoreline in the longshore sediment transport system. The breaks in the sand/storm bars seen in this slide also demonstrate one of the theories of rip current formation.

Following the storm due to changes in wave characteristics, the sand/storm bars migrate landward and weld onto the beach. Subsequently, winds pick up the finer grain material and deposit it back up onto the dunes initiating natural rebuilding of the dunes. Sometimes the dune will re-form in the same location/footprint, but it could also rebuild slightly farther landward, depending on a multiple of factors. This is a photograph taken in December 1994 following a moderate coastal storm. Note the position of the seaward toe of the dune. The next photograph is the same location as the previous slide but was taken three months later demonstrating the natural dune rebuilding process. As you can see, the dune basically reformed in the same pre-

storm location, primarily as a result of windblown sands. It is important to note that the sand that rebuilt this dune came not only from the beach, but the sand was also transported by winds from landward areas due to the prevailing westerlies. So it is important to allow unimpeded movement of sand both in the onshore and offshore directions, as well as laterally, to allow maximum recovery or rebuilding of dunes. The unimpeded movement of beach and dune sands by both wind and wave activity is an activity or interest required to be maintained by the Wetlands Protection Regulation performance standards in order to allow those dunes to optimally function.

These beach/dune processes happen not only as a result of storm waves, but also occur on a seasonal basis as well. This is primarily the result of increased frequency and intensity of coastal storms. During winter months a nearshore sand bar, or series of sand/storm bars, form offshore and reside there over the winter months. During early spring and summer the nearshore sand/storm bars migrate landward and eventually weld back onto the beach and generally remain welded onto the beach for the remainder of the summer season, unless a moderate or greater storm makes landfall. So, fortunately, we experience beautiful high, wide beaches for our enjoyment during the few months that we are blessed with warm weather.

Relative sea level rise is also a major consideration in Massachusetts. The Woods Hole Oceanographic Institution conducted a sea level rise or coastal submergence study in 1989 for the Coastal Zone Management Office. The results of that study revealed that the landmass along coastal Massachusetts is sinking along with the eustatic level of the sea rising. This results in an approximate rate of relative sea level rise in Massachusetts of one vertical foot per 100 years. This is a major consideration in many coastal areas, particularly along heavily developed or low-lying shores. Sea level rise is continuing and that rise is predicted to accelerate in coming years. So, not only the location but the elevation of dwellings being constructed today may not be adequate in the not distant future if relative sea level rise and erosion rates are no taken into consideration.

Overwash is another extremely important coastal process. This is an aerial photograph of Long Beach in the Town of Plymouth on Cape Cod Bay taken about a week after the October 1991 storm. Overwash lobes or fans along the backshore are clearly evident. The unvegetated overwash lobes are the result of storm waves overtopping the barrier during that major October 1991 storm, while the large vegetated overwash lobes were created during the 100-year storm, the great Blizzard of 1978. The overwash lobes/fans, consisting primarily of sand, pebble and cobble, provide a substrate for subsequent dune and marsh growth.

If overwash was prohibited from occurring, I suggest that the barrier would be much narrower than it is today. This quite evident by drawing a line down the backside of the barrier in such a way as to eliminate the overwash areas. If the seaward side of the barrier beach were armored with rip-rap or other coastal engineering structure -- which is generally proposed along an eroding or storm damaged shoreline -- eventually due to continuing erosion high water would

be forced against the structure on the seaward side. Furthermore, overwash would be prevented from occurring or would occur less frequently thereby eliminating the overwash lobes on the landward side. Thus, eliminating these overwash lobes would result in a much narrow barrier beach with the high water line inundating what is now dune and beach on the landward side. Ultimately, the storm damage reduction and flood control characteristics to landward areas, as well as wildlife habitat provided by the overwash lobes would not exist without the process of overwash.

So, I would suggest that if overwash processes were prohibited from occurring, a narrowing and hastened demise of this barrier beach would result. Storm damage prevention, flood control, and wildlife habitat characteristics provided by dunes, beaches, and barrier beaches are all interests protected under the standards of the State Wetlands Protection Regulations.

Overwash, in some cases however, is not always desirable. For example, this slide shows Ballston Beach, along the Atlantic Ocean shore of Truro. The overwash of this barrier has resulted in inundation of areas supporting septic systems and drinking water wells. A study is underway of the potential impacts to the Pamet River ecosystem and developed areas from anticipated continuing overwash and/or breaching of the barrier beach. The results will facilitate a decision of whether to prevent or minimize the overwash depending on the identified impacts.

As seen here, the dunes where the overwash occurred have rebuilt naturally, primarily as a result of installing sand/snow fencing: actually there are three sand fences, two buried in the accumulated sands and one visible. The dunes have recovered naturally primarily because the coastal banks or bluffs on either side are unarmored, providing tremendous amounts of sand to that longshore transport system. The uninterrupted movement of those sands by winds and waves has allowed the barrier beach to significantly rebuild itself.

Available options in responding to eroding shorelines can be divided into both proactive and reactive modes. A variety of techniques that are available to address erosion, both proactive and reactive, will now be provided.

Reactive options to erosion as shown here include hard or soft stabilization techniques, as well as relocation or retreat. For example, this is a postcard dated August 1913 showing the eroding shoreline along Third Cliff in the Town Scituate. The bluff is obviously eroding, and providing material to a sandy beach fronting the bluff. Through the longshore sediment transport process, the sandy-cobble material is being transported away from the bluff source and contributing to the existence of Peggotty Beach, a barrier beach. Much to the chagrin of the property owners at the top edge of the eroding bluff, the properties are endangered due to on-going erosion.

This slide shows the same area as it exists today. Due to the erosion concern of the bluff and the threatened dwellings, the bluffs were stabilized by constructing a rip-rap revetment.

The houses at the top edge of the bluff are now relatively well protected, but due to the loss of source material and on-going erosion, the fronting beach has been eliminated. It also removed material from the longshore transport process, and as a result, depending on the volume of material eliminated, downdrift erosion will be accelerated causing impacts to downdrift properties. Referring back to the previous slide, some of the source material for this barrier beach most likely came from the formally eroding Third Cliff bluff. The houses in were subsequently purchased by the federal government. Twenty houses and properties have been purchased and removed from Peggotty Beach because of erosion and ongoing storm damage.

The selection of hard stabilization alternatives is very site specific. Vertical seawalls, rip-rap revetments, or gabions all have benefits, as well as detriments. We now understand the results of armoring coastal banks which are sediment sources, so now we will turn our attention to dunes. Vertical seawalls in dunes or sandy areas that exist today were built many decades ago, prior to having the understanding of coastal processes that we have today. Due to our present-day understanding of the importance of dune function, they are generally not allowed to be armored. The Wetlands Protection Regulations limit activities that prohibit dune sands from eroding, and/or migrating in any direction, or any activity that would destabilize a dune. Thus, the selection of erosion control or storm damage reduction alternatives is very site specific based on erosion rates, flood zones, and the type of landform and its overall function and importance to the littoral system.

This slide (see Figure 4) summarizes the impacts of these erosion control structures. Obviously they will provide temporary protection to landward dwellings to varying degrees. However, some volume of source material is going to be eliminated from the longshore transport system, thereby accelerating downdrift erosion to some degree. In addition, in many cases a problem on the downdrift side of coastal engineering structures, such as seawalls and revetments, occurs. 'Flanking erosion or end scour' is oftentimes observed at the terminal ends of shore parallel structures. This results from the interaction of waves and/or currents with the structure. So, generally some degree of accelerated erosion or scour occurs on the immediate downdrift side of these structures. 'Returns' are generally constructed diagonally at the ends of seawalls, revetments and bulkheads, which can reduce downdrift flanking or end scour, however, it appears that flanking cannot be eliminated in the areas subject to wave activity. It can be minimized, but it is very difficult to prevent it.

Wave reflection, particularly from vertical seawalls or bulkheads, has been responsible for causing scour of, and thus accelerated loss of material from a fronting beach, at least during the storm events. The scour trough generally fills quickly following the storm, but the suspension of material as a result of wave reflection off these walls will result in material moving more rapidly off site. But the trough generally fills fairly quickly immediately following the storm.

This photo depicts what happens when the on and offshore movement of sand from dunes is prevented. This is Long Beach, a barrier beach, in the Town of Plymouth. As you can

see, dunes are absent landward of the dike. Dunes cannot form because eolian or windblown sands from the beach cannot overtop the dike. Barriers built on eroding shores eventually result in forced high water against the structure. Dunes cannot form on the landward side of the barrier beach, and as a result of wave overtopping it appears that the barrier itself may actually be separating or migrating landward away from the dike.

This slide shows the northern end of that dike on the same beach where the dike meanders landward and disappears into dunes into the central portion of the barrier. The dike was built at the turn of the century in response to the impacts of Portland Gale of 1898. Here looking northward, exist very large dunes. This picture was taken immediately following a storm, and dune scarps are evident. However, a very large dune exists providing storm damage prevention, flood control, wildlife habitat, not to mention aesthetics. Extensive dunes exist along this section of the barrier beach and not the southern section because eolian (windblown) sands can move freely without the impediment of the dike resulting in dune reformation following storms. So, this is clear evidence that dunes continually respond and reshape and reform to the forces acting upon them. The dunes have reformed slightly landward of their pre-storm location, but in areas with an adequate supply of sediment, dunes will continue to develop in height and volume.

If alongshore transport of sand is interrupted, the anticipated results are fairly obvious. Sand moving in the longshore system that is interrupted by a shore perpendicular structure, such as a jetty or groin, will be trapped on the updrift side. This will buildup the beach on the updrift side, preventing that volume of trapped sand from reaching the downdrift side resulting in some degree of downdrift erosion. Jetties are shore-perpendicular structures generally built to keep navigation or tidal channels open, while groins are built along a shoreline to buildup a beach. Jetties are generally much longer than groins, and both are generally constructed of rip-rap, although groins have been constructed of wood or sheetpiling as well. This slide shows an example of massive volumes of material (sand) trapped on the updrift side of shore perpendicular structures, preventing sand from reaching the downdrift side, most notably in immediate downdrift area. What happens is that sand is by-passed around the groin or jetty coming ashore some distance downdrift, the distance depending primarily on the length of the structure. This general heightened erosion problem in the immediate downdrift side or shadow-zone of a groin or jetty not only accelerates immediate downdrift erosion, but could also increase wave and floodwater inundation, as well as overwash in the shadow zone area. In limited cases this could cause more frequent overwash or in rare cases more frequent breaching of downdrift barrier beaches.

Here is the south side of Cape Cod on Nantucket Sound. It shows that a combination of shore-parallel and shore-perpendicular structures can also be responsible for accelerated landward migration of barrier beaches. Popponessett barrier beach in Mashpee was, in the past, much more seaward than its present location. The barrier beach at one time extended almost all

the way to Dead Neck (the barrier beach on the top right side of the photograph). Through a combination of both natural and human-induced causes, such as a diminishment of sediment sources, this barrier beach has migrated a significant distance landward. Due to this lack of sediment in the longshore sediment transport system, frequent overwashing and occasional temporary breaching occurs.

There are management techniques that can applied to mitigate impacts resulting from existing shore perpendicular structures. Provided that no development occurred on the updrift accretion side, a groin could be lowered, shortened or made more permeable. This would allow more sand to flow through and around the structure in an attempt to obtain a greater equilibrium to the shoreline configuration. Considering balancing development on either side of groins, if appropriate removal of the groin would result in a straightening of the shoreline, eliminating the downdrift offset. A very site specific analysis considering the impacts of groin removal or alteration of these structures is required.

This slide shows offshore breakwaters. Construction of offshore breakwaters is not common these days. They have been shown to be extremely expensive and, in many cases relative to other alternatives, cost prohibitive in terms of initial construction and maintenance. Do breakwaters work? In some cases, yes; in some cases, they've backfired and actually caused accelerated erosion on the landward property. This is the Five Sisters breakwaters offshore of Winthrop. As you can see, there is sand buildup immediately landward of the breakwaters. This is beneficial for the immediate landward structures, but what does that do in terms of interrupting the longshore sediment transport? It removes sand from being transported to the downdrift area causing some degree of accelerated downdrift erosion.

Gabions are another erosion control alternative generally proposed in more quiescent waters, however not necessarily appropriate in Velocity-zones. A Velocity-zone being that part of the coastal flood plain that can support a three foot or greater wave under 100-year storm conditions. This slide (see Figure 5) shows gabions which, in this case, were built in a Velocity-zone: they are not necessarily contributing to their design objective. Gabions are generally built in bays and estuaries and more quiescent waters. There they can trap eelgrass and other aquatic vegetation and aesthetically blend into a coastal bank.

Over the years a variety of very creative erosion and shore protection techniques have been attempted. However, non-engineered attempts generally fail shortly after installation. Sand bags are generally used on a temporary basis to allow a property owner and the review agency time to determine a more appropriate approach that will address the problem on a long-term basis to help provide erosion, storm wave and flood protection.

There are a few experimental storm damage mitigation and erosion control methodologies in place in the Commonwealth, as well as around the nation. This slide shows the Sta-Beach beachface dewatering system, an experimental erosion control technology that was installed along the eastern shore of Nantucket in 1994. It is an attempt to try to trap sand

from the longshore transport system and keep it on the beach face itself. As stated by the proponents, the purpose of the project is basically an attempt to build up the beach or at least slow erosion of the beach. Extensive monitoring of the system performance is on-going. If successful, on-going erosion of the coastal bank backing the beach may be slowed as well, thereby extending the life of the structures that are located close to the edge of the bank.

Based on monitoring results to date, the system does not appear to be meeting its design objective. The monitoring results are inclusive primarily because the pumps and electrical system do not operate consistently. Other components, such as the discharge pipes continue to be damaged as a result of the extreme high wave energy environment within which the system is located. An erosion rate of upwards of 10 feet per year have be measured in the southern parts of the project area, and dwellings are continually lost in that area of Codfish Park.

Of the erosion and storm damage mitigation techniques that have the least potential adverse impact, there is nourishment. Nourishment falls into several categories: beach nourishment, bank nourishment, and/or enhancing dunes, all providing enhanced storm wave and flood protection to landward areas.

For example, a major beach nourishment project -- a designed or engineered project that is -- has a life expectancy and a positive cost benefit calculated based on the coastal processes that have and are presently occurring in the project area. However, the caution being if geomorphic conditions vary from the linear curve, the project may not end up being cost effective. Beach nourishment has, however, worked well in many other states. The technique has been stated to have worked successfully in three cases in Massachusetts. By that I mean three major engineered beach nourishing projects; projects in which design engineers claim that it has met its cost/benefit protection and longevity predictions.

Minor dune restoration projects, with dune/snow fencing and planting stabilizing dune vegetation have worked quite well. Here is Humarock Beach in Scituate: the beach that I showed you previously that had no development in its northern section at the turn of the century. This slide shows a 'sacrificial dune' that provided some degree of storm and flood protection through a storm that occurred only months after it was installed. It is a good technique to add sand into a sand starved system.

There are also a number of coastal bank stabilization techniques, such as erosion control matting, fiber rolls and bio-logs (both biodegradable), or more permanent, nondegrading material. From an environmental impact and landform function perspective, biodegradable materials are preferable. These are generally placed on a bank that has been graded to a stable angle, with vegetation planted at the bank toe, as well as throughout the bank, to help slow erosion and provide protection for structures located close to the top of the bank. These techniques are particularly important due to the Wetland Protection Regulation prohibition of structurally armoring an eroding coastal bank to protect a building constructed after August 1978.

Eroding coastal banks to protect buildings that were built after August of 1978, which is the promulgation date of the Coastal Wetlands Regulations, cannot be considered for coastal engineering structures such as seawalls and revetments primarily because we finally understood the science and the critical importance of the role material eroding out of that bank plays. Removing that material from the longshore system by armoring its source contributes to downdrift erosion, and thus adverse impacts to the beneficial functions of downdrift resources. So, that August 1978 date is an important consideration when reviewing projects under the Wetlands Regulations.

Selecting a coastal bank stabilization technique is very site-specific and very engineering-specific. Many creative proposals have come forth. Here we see a revetment on one side of the property, and, based on adjacent site parameters, the property owner, in consultation with an engineer, decided that perhaps a revetment wasn't necessary in this particular location. As a result, bank regrading to a stable angle with biodegradable erosion control matting supplemented with vegetative planting was installed. This emphasizes that the selection of the erosion control or storm damage mitigation technique is very site and engineering specific. These non-structural techniques are very effective in some areas, and not in others. But it's important to consider all of the alternative management techniques that are available, both hard and soft stabilization techniques.

A critical parameter to incorporate into selecting a design, particularly in dune or barrier beach areas, is the rare and endangered species habitat protection requirements under the Wetlands Protection Regulations. No short- or long-term impact to a mapped rare species habitat is allowed for any activity, such as we see in Long Beach in the Town of Plymouth.

Other non-structural storm, flooding, and erosion control techniques which avoid attempting to fight or control natural processes is addressing the dwellings themselves. One such approach as shown in here is elevating the structure on pilings, with the lowest horizontal structural member above the base flood or 100-year flood elevation. This allows waves to cascade under the house, thereby directly preventing damage to the structures itself. Elevating a structure or building on open piles is one of the only techniques that's allowed in a dune or on a barrier beach. This allows the dune to continue to reshape and reform to the forces of waves and winds, and to continue to contribute to the sand sharing system with the beach and nearshore areas. In other words, the dune can continue to provide its beneficial functions of storm damage reduction, flood control, and wildlife habitat, and not adversely impact other properties.

Elevating structures in dune and beach areas on open pilings is generally an accepted practice, provided that the structure will not impact or destroy dune vegetation to a point that would destabilize the dune and therefore negate the dune interests under the Wetlands Regulations.

Aesthetics and community character are not interests under the Wetlands Regulations, but are certainly of interest to the community. This slide shows structures located along the western shore of Buzzards Bay. It was taken a couple of years after Hurricane Bob which made landfall in 1991. All structures located on the barrier beach, which were on solid foundations, were destroyed by Hurricane Bob, and the few remaining had to be demolished due to unsafe conditions. This is what the barrier beach looks like today following the reconstruction phase. Elevating a dwelling on open pilings definitely helps minimize the impact to the beneficial functions of coastal landforms, as well as provided a measure of protection to the structure itself. However, it is not the panacea either.

While it is not a frequent occurrence, it does occur on occasion: pilings can snap. But more importantly, if the structure is located along an eroding shoreline, the loss of material under the house results in erosion and more frequent wave inundation of the site. As the high water line continues to move landward due to erosion, the flood and wave elevations could subsequently affect the structure. The depth of pile penetration is also a concern. Following Hurricane Bob several dwellings had to be demolished even though the superstructure was intact: the pilings tilted and made the dwellings unsafe. Note the 'for sale' sign on the house if anybody is interested.

Removing or relocating dwellings will obviously eliminate an existing hazard and allow the landform to reform and function naturally. This structure is on the eastern shore of Nantucket following the October 1991 northeast storm. There comes a point when both structural and non-structural erosion and storm damage mitigation techniques cannot provide the desired protection. At some point, a decision to relocate the structure either landward on the lot or, in some cases, off site must be made. Relocating a structure is obviously a successful technique that eliminates the hazard.

Another hazard mitigation management technique is development setbacks. Setbacks based on erosion or storm parameters are not required under Massachusetts state regulations. Setbacks are, however, incorporated into several local municipal by-laws. This is Isle of Palms in South Carolina where setback regulations are in place. It is obvious that structures located well landward of an eroding shoreline or far from the damaging capabilities of storm waves are well protected; this can be accomplished with setback requirements. However, along an eroding shore, the protection is only temporary. The problem is put off for future generations. But it is a technique that will work to allow people to use and enjoy their shorefront property for at least a period of time.

If possible, relocating a structure out of a hazardous location, or acquiring the property and placing a preservation restriction would 'eliminate' not only the existing hazard, but would prevent future generations from having to deal with future hazards. This is such a site located in the Town of Truro. A collaborative effort was initiated to purchase this property through Federal Land and Conservation Funds which are administered on the state level with the Town

of Truro. This is an aerial photograph of Duxbury Beach in Duxbury and Plymouth which was purchased in the early 1900s. A 40-lot subdivision was proposed on this barrier beach. Based on shoreline change data from the Coastal Zone Management Office, the area where the subdivision was proposed has migrated landward approximately 140 feet. Had that 40-lot subdivision been constructed, and had this not been purchased by a nonprofit organization for preservation, we would have some very serious consequences, not only for the landowners but for many people who have to respond to disasters.

Prohibiting development in known hazardous coastal locations is also a management technique which prevents disasters and harm to people. With knowledge, data, maps, and historic information that exists today, hazardous coastal locations are known, and most are mapped. If construction takes place in these areas, it is known beforehand that ultimately a hazardous situation will arise. So prohibiting development in the most hazardous known areas is another pro-active management technique available, however, not without its legal implications.

Why understand all this information? In order to allow people to use and enjoy their coastal properties, while attempting to prevent or at least minimize the economic hardships and human disasters that will occur that accompanies uncontrolled or unwise shorefront development. A classic example is shown here, Peggotty Beach, after the Great Blizzard of 1978 -- or actually during the Blizzard of 1978. Most of the structures along this beach have been repeatedly damaged or destroyed. What we're trying accomplish is to prevent damage not only to structures which economically impact individuals, communities, and the nation as a whole, but attempt to keep people out of harm's way, and tragic dislocations following coastal disasters.

Throughout this presentation many of the parameters of the Wetlands Protection Regulations were summarized as they relate to scientific principles of physical coastal processes and coastal landform functions.

Following this presentation, you will be presented with a hypothetical, multifaceted shorefront development proposal. We're going to creatively analyze the proposal and apply the coastal processes principles just presented. During the review of this proposal, each of us will collectively determine whether or not the project should be allowed; and if allowed, what changes to the project or conditions should be placed on the project that would minimize or eliminate adverse impacts to the beneficial functions of coastal landforms and downdrift property. Are there even conditions or management techniques which could minimize or eliminate the impacts from this development proposal? I was hoping that by conducting this presentation before we go into breakout sessions to review this complex shorefront development proposal to open up your mind and provide information that would allow you to creatively discuss the science, creatively discuss the parameters that you see that are necessary to minimize impacts not only to the adjacent and downdrift property, but also to minimize what

we may see as potential future impacts. Be creative! We're going to try to review the project under the parameters of the science that was just presented. That science forms the basis of the Performance Standards of the Coastal Wetlands Protection Regulations.

In summary, coastal banks provide the primary source of sediment which supplies our beaches, dunes, and barrier beaches. Coastal Engineering structures, such as seawalls, revetments, and bulkheads proposed to be built on eroding coastal banks to protect buildings constructed after August 10, 1978, are generally not allowed. Dunes must not be prevented from migrating in any direction and, must be allowed to erode, supply sediment to beaches, and then reform following storm events. The form and volume of the dune cannot be altered in such a way as to diminish its capability to provide storm damage prevention and flood control, or wildlife habitat. In other words, the function of dunes cannot be interfered with. If longshore sediment transport or littoral drift is interrupted, certain downdrift impacts can be anticipated as presented earlier.

I'll leave it at that, and allow us to now creatively look at this hypothetical shorefront development proposal. Open up your minds and creatively apply the coastal processes principles presented earlier and determine whether or not this development proposal can or even should be permitted. If permitted, what will be the potential impacts, and what conditions may be warranted to minimize or prevent anticipated impacts. Or, should the development proposal be permitted at all? I look forward to a very creative discussion in the breakout sessions.

DR. GIESE: Thank you, Jim. You end at a good time because we have a very full morning. You gave us about 10 minutes to have a quick cup of coffee, but before we do that, I'd like to go through where we are.

We'll have the discussion within our groups in those locations that I've mentioned before from 11:00 to 12:00 followed by a large group discussion. Then after that we'll have lunch.

MR. O'CONNELL: The one slide that's left in the tray is the development proposal.

DR. GIESE: Will you show that now? This is a good time. This works in very well.

What Jim is going to do is, as part of the breakout group discussion, is have us all work on a problem, actually a set of interrelated problems, showing the interrelated relationship of shore processes and management dilemmas.

MR. O'CONNELL: This development proposal I'm about to show and describe is actually a consolidation of many real projects that I and others in the audience have dealt with. So I tried to bring a number of issues together. This (Figure 6) is the project that we're going to discuss and review in our breakout session. We will determine all potential impacts to coastal processes and landforms, how we can mitigate or avoid impacts, determine if it can be permitted, and if so, what conditions should be placed on it.

Refer to this graphic (Figure 6) which is the proposal that we're all going to review in our creative breakout sessions. First, there is a 100 foot high, obviously eroding, coastal bank

providing sediment to the downdrift barrier beach. The coastal bank itself is eroding at approximately two feet per year, and is approximately 100 feet high. A barrier beach exists downdrift of the bank, with a section of mapped 'actual' rare species habitat. In fact, the entire barrier beach is 'potential' rare species habitat. A cottage colony exists on the barrier that was built around the turn of the century. The barrier beach is migrating or eroding at approximately two and a half feet per year, based on the long-term average annual erosion rate.

Two vacant lots exist atop the coastal bank. Two existing houses on the eastern side of the bank are in close proximity to the edge of the bank: both built in 1959. A third house built in 1984 exists on the western portion of the bank. Two vacant lots exist atop of the coastal bank sandwiched in between the existing houses.

The proposal is this: Two new houses are proposed to be built on the vacant lots atop the coastal bank. The lots are approximately 120 feet wide 120 feet deep. The applicant would like to build houses on each of the lots, and would also like to have a pile-supported pedestrian walkway down the bank to the beach.

The applicant also proposes to build a boathouse in the back dune area on the barrier beach on a concrete slab foundation to help provide stability to the boathouse. The coastal bank is eroding and the applicant does not want to run into future problems, so a vertical concrete seawall is proposed to abate the coastal bank erosion problem. Not only is a seawall proposed, but the applicant has joined with neighbors and consolidated and expanded the proposal to build a continuous seawall along all properties to help prevent a flanking or end scour effect that is generally caused by seawalls. So, all of the homeowners propose a continuous seawall to help provide protection not only for the older houses but for the newer and proposed houses as well. However, the owner of the house on the western (right) section atop the bank does not want a seawall. They have adequate access down to the beach, and they're pretty satisfied with what they have. They don't want anything to do with the proposal.

So, in summary, two new houses, a pile-supported pedestrian walkway, a boathouse on a concrete slab foundation, and a vertical seawall to help provide protection for the four houses. The concrete slab foundation is proposed to help provide stability to the structure itself so it doesn't move as the dunes migrates.

The thin sections of barrier beach on the western side (between the bank and proposed boathouse location) and the eastern (right) side are areas subject to frequent overwash. In addition, the mapped rare species habitat area has frequently overwashed and breaches occasionally, particularly during major storms. When the barrier beach breaches, it allows storm waves to enter the landward Bay causing damage to the shoreline and houses along the Bay. For some reason, this breaching seems to be getting more frequent in recent years.

To provide further protection to the boathouse because of its location in an overwash area, the proponents propose to build a groin. It is anticipated that the groin will trap longshore sediment, help build up the beach, and result in the updrift dune gaining volume, which in turn

will help provide somewhat more protection for the beach and boathouse through the enhanced function of the dune. The applicant wants to install snow fencing and plant dune grass to help stabilize the sand as it accumulates on the updrift side of the proposed groin. The longshore sediment transport direction as indicated is from west to east (left to right).

This diagram, as well as the project description I just described, will be provided to you when you go into the breakout session.

Let's open up our minds, be creative, explore impacts and options, and determine whether or not this project can be permitted, and if so, under what conditions.

Figure 1

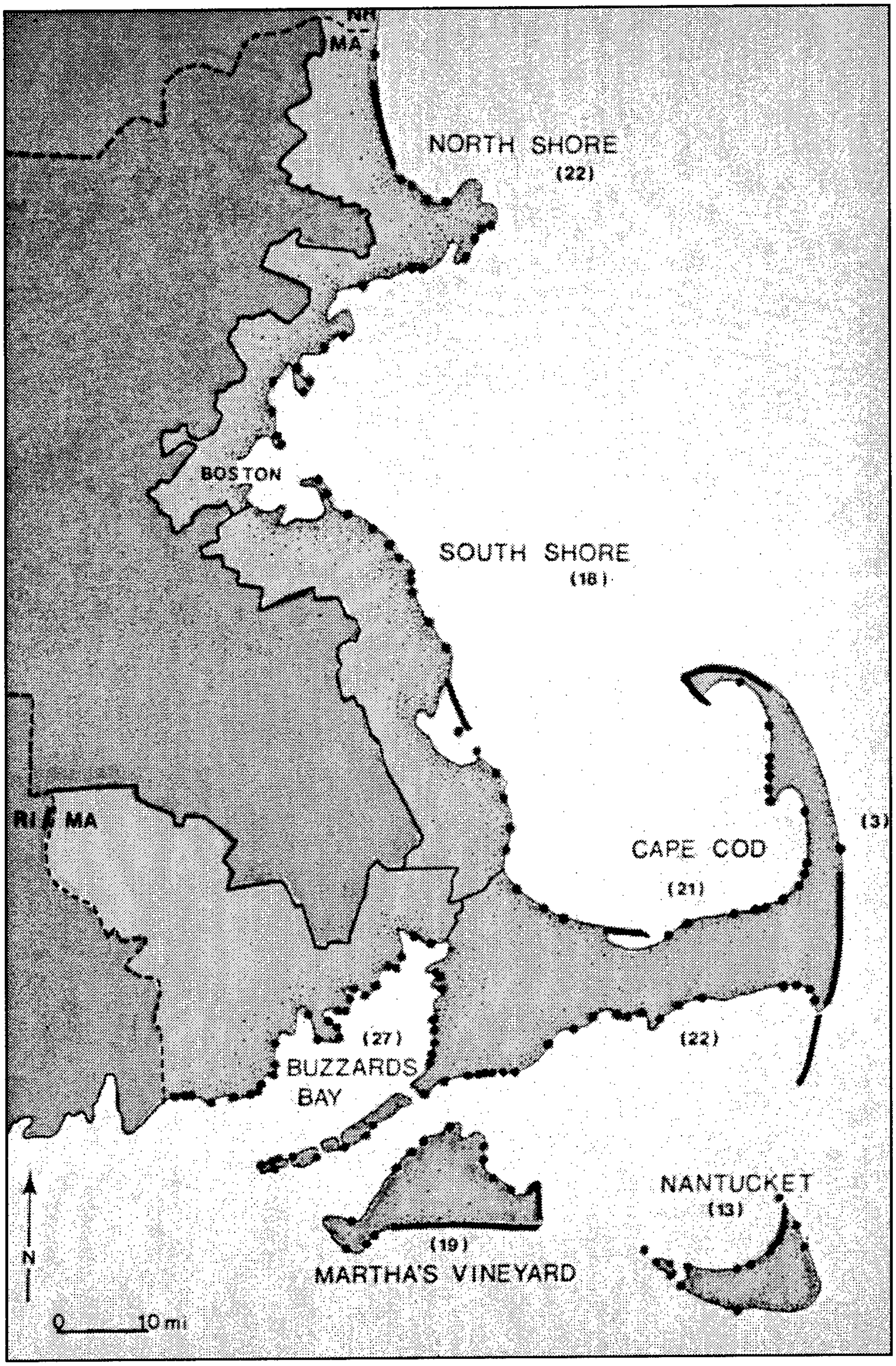

NH
MA
NORTH SHORE
(22)
BOSTON
SOUTH SHORE
(18)
RI MA
CAPE COD
(21)
(3)
(22)
(27)
BUZZARDS
BAY
NANTUCKET
(13)
(19)
MARTHA'S VINEYARD
N
0
10 mi

Figure 2

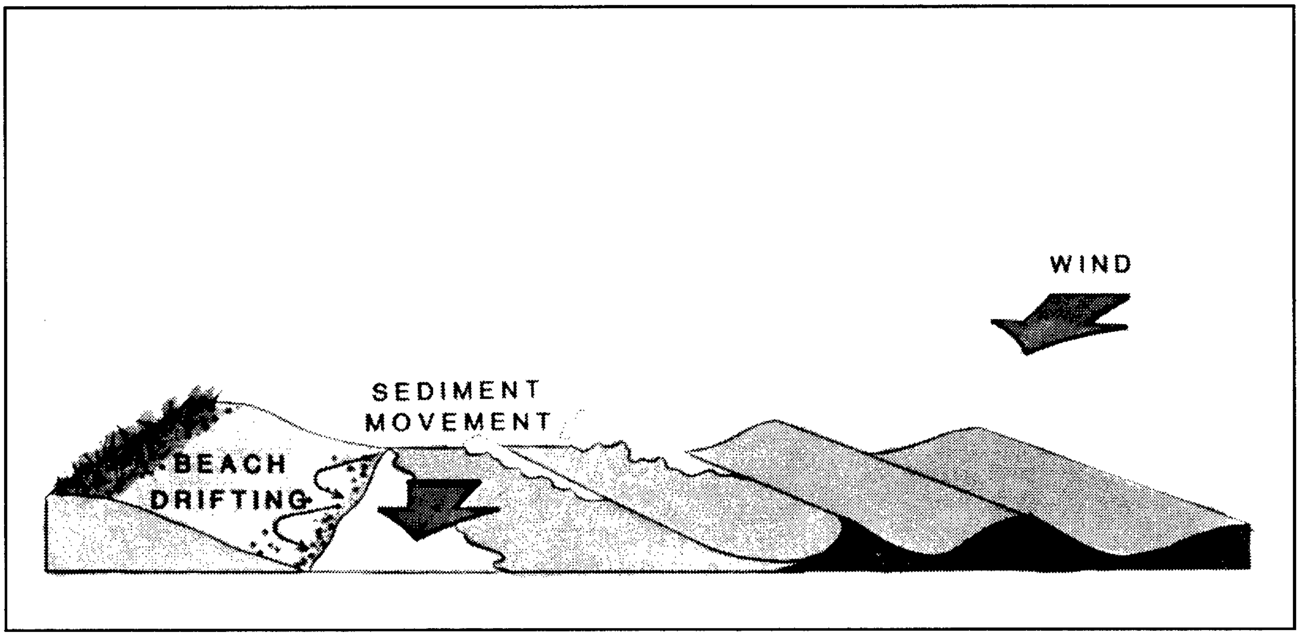


Figure 3

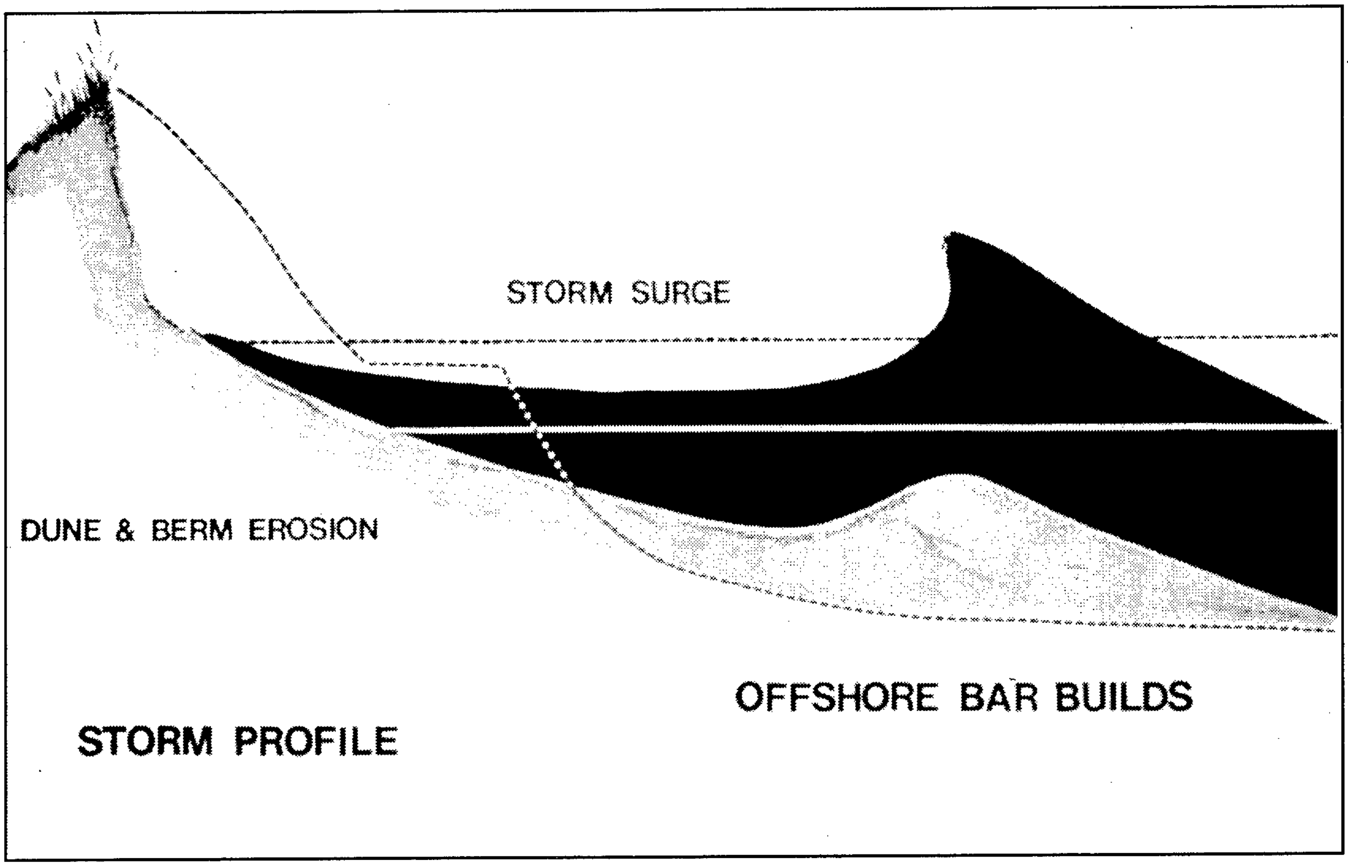

STORM SURGE
DUNE & BERM EROSION
OFFSHORE BAR BUILDS
STORM PROFILE

Figure 4

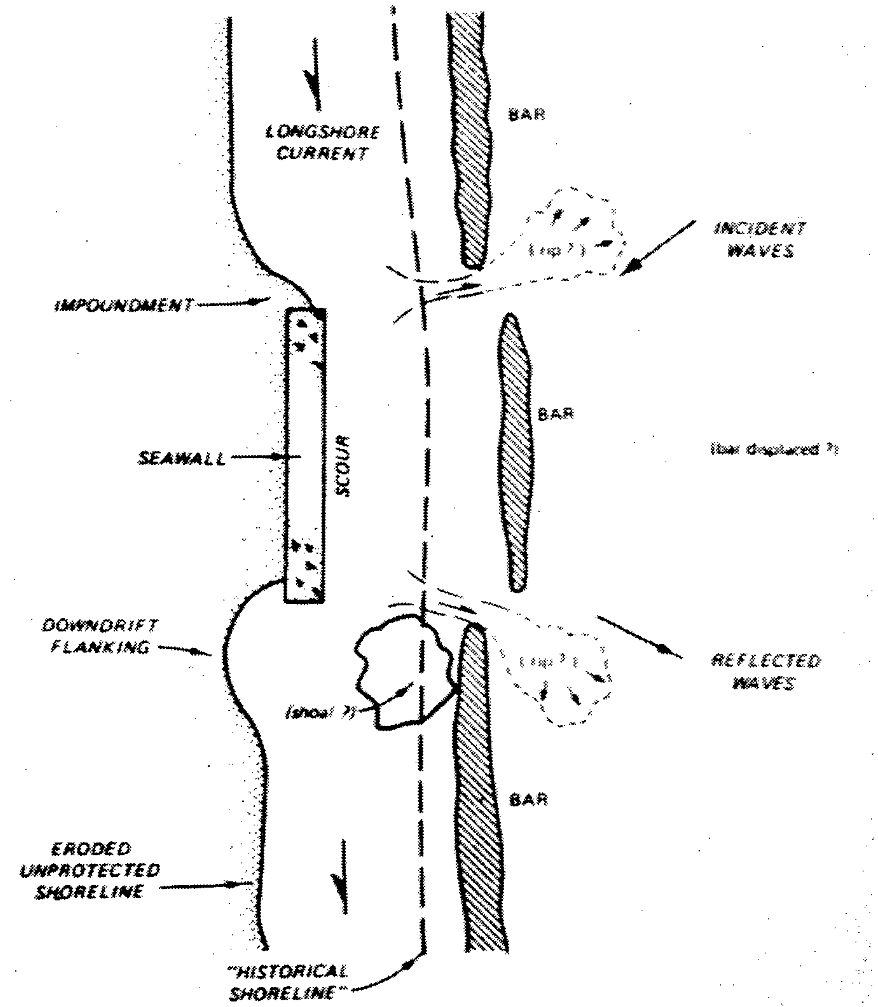


Figure 2. Plan view of potential impacts of seawalls.

(modified from Kraus, N.C., 1988, The Effects of Seawalls on the Beach: An Extended Literature Review, Journal of Coastal Research, Special Issue #4.

Figure 5

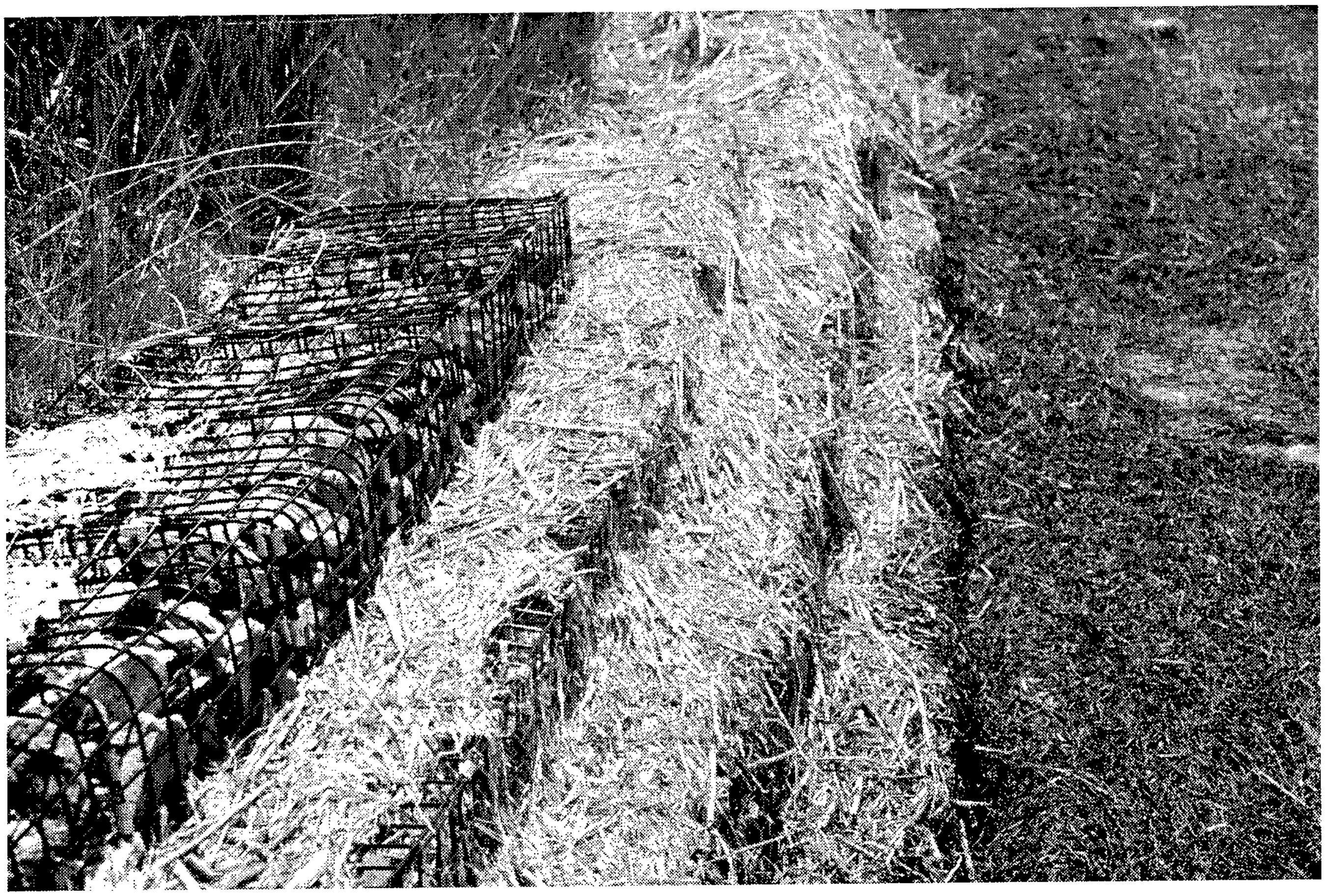
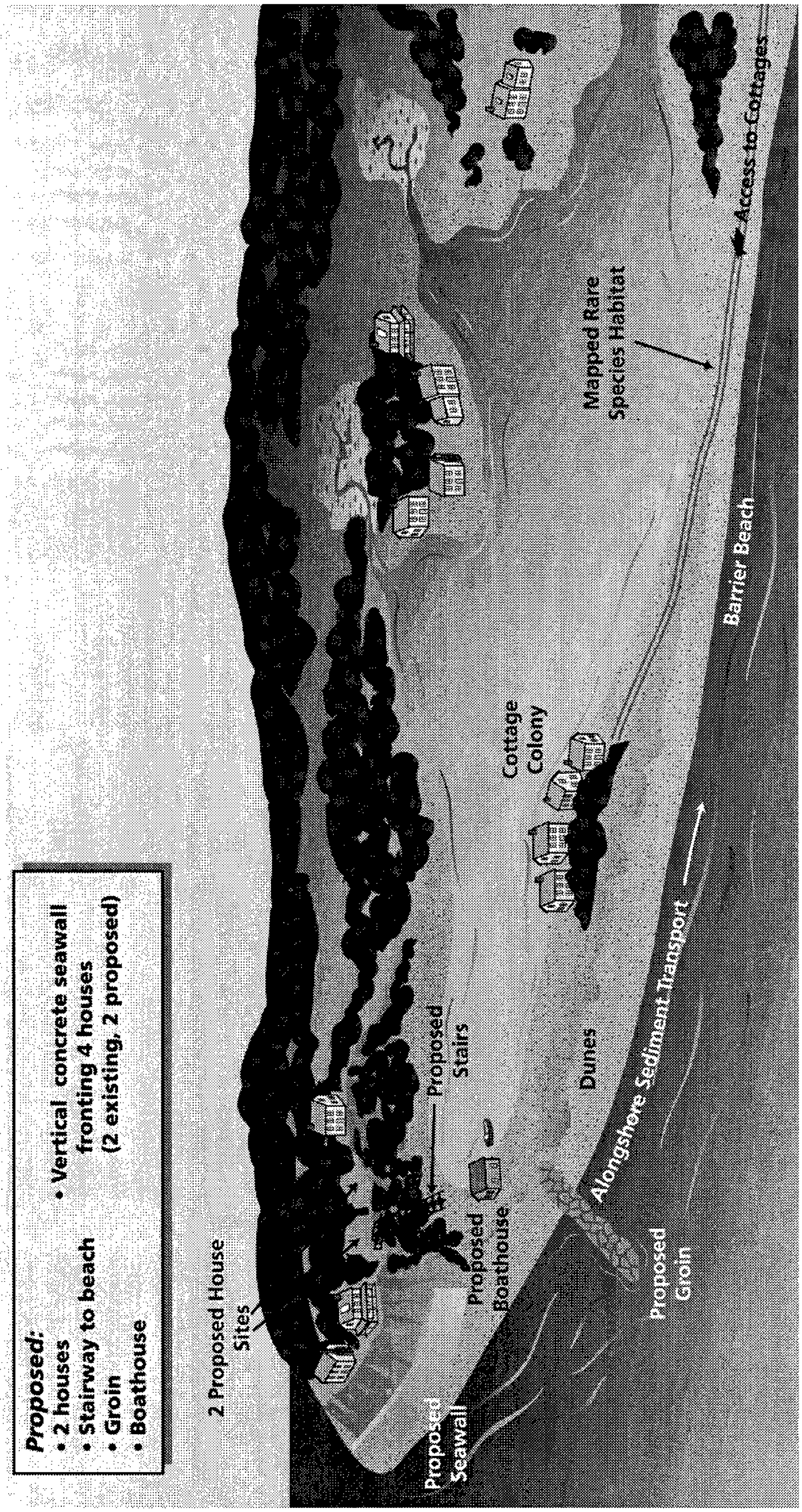


Photo provided by Jim O'Connell, MCZM

Figure 6


Proposed:
• 2 houses
• Stairway to beach
• Groin
• Boathouse
• Vertical concrete seawall fronting 4 houses (2 existing, 2 proposed)
2 Proposed House Sites
Proposed Seawall
Proposed Boathouse
Proposed Stairs
Dunes
Proposed Groin
Alongshore Sediment Transport
Cottage Colony
Barrier Beach
Mapped Rare Species Habitat
Access to Cottages

Reports from Breakout Group Facilitators

MR. O'CONNELL: Let's begin this aspect of the workshop. We have only 20 minutes to discuss what each group decided.

From drifting around to the various group discussions, I heard quite a bit of differing feedback and quite different approaches. We were, I think, having a very enjoyable time discussing a very serious proposal.

What the panel representatives would like to do now is summarize what each of the four breakout groups came up with. You've heard your group discussion and results; let's hear what the other groups came up with.

So lets start by summarizing, breakout-group by breakout-group, the different aspects of the project, whether it was approved, approved with the conditions, or aspects denied. We'll begin with group color green. Julie, tell us what the group came up with.

MS. EARLY: Our group had a good discussion of many issues involved with coastal development, as I'm sure the other groups did as well. We agreed that the houses should be approved with conditions such as set-back requirements. They also approve the stairway with conditions. Possibly there would be some safety considerations and requirements for upkeep and, when and if necessary, removal requirements. If changes in the stairway were proposed, the Commission would have to vote further approval.

The boathouse raised other concerns for the group. They could not agree on whether or not to allow it to be constructed but mentioned that the building should be required to be built on pilings as a condition, if it were to be approved.

The groin was denied.

We didn't come to a conclusion on how to handle dune grass or fencing, although they were discussed in relation to the boathouse.

And finally, the seawall was approved with modifications and a discussion of the 1978 structure ruling. And that was it. Thanks.

MR. HENSON: The proponents really got beaten up in our group. On the vacant lots, our group approved the proposal with conditions including: setback from the top of the bank; a requirement for sloping the yard areas away from the top of the bank to minimize rain runoff; and a prohibition on the construction of coastal engineering structures in the future. The stairway was an issue that we couldn't arrive at a consensus on. There were some who felt that it's construction should be encouraged in order to minimize impacts to the bank; others felt that given the erosion rate it would ultimately become a hazard. So, we didn't really get anywhere on that. The boathouse and groin were denied, with the "commission" citing Executive Order 181, and significant potential impacts to the resource areas.

The dune grass planting scheme was approved but modified to support aggressive vegetation on the bank area. The fencing was denied. And, the seawall clearly was going to

cause too many impacts the resource areas. So therefore, it was denied without prejudice in hopes that the proponents would come back with some modification of that plan.

DR. LEAVITT: The blue group had a good discussion on the development of the area in question, and it pretty much follows what the previous groups have concluded. Our poor engineer designee got beat to death in the discussion.

House One and House Two were approved with a 60-foot setback requirement.

The stairway was approved with conditions that it be removable and also that it be designated as a common-use stairway for all of the houses on the bluff.

With respect to the boathouse, while we didn't discuss it much, the group had two different opinions. The majority opinion was to approve it conditioned to being built on pilings and the minority opinion was to deny it.

The groin was unanimously denied. Because of that, the dune grass and fencing, which we equated as part of the total groin proposal, was also denied.

The seawall was what the group spent most of the time discussing and it was denied as proposed. We really couldn't come to a consensus as to what conditions might be put on it. There was considerable discussion about various construction technologies such as geo-tubes and ripraps as well as revegetating the bank.

DR. PEDERSON: Almost everything has already been discussed, so I'll just quickly go through this.

Our group also had a lot of fun with the role playing exercise. As proposed, the project would not meet all of the policies. Throughout the course of the working group session, most of the alternative approaches available to the housing project proponents and those who were already living there were discussed. Even though abutters did not think the project should move forward, as a group, the Conservation Commission said that they, indeed, would approve the house -- the two houses. The regulations offer no reason not to permit the project. However, the working group did suggest several modifications. For example, several members of the group brought up the issues related to appropriate drainage to prevent the top of the bank from eroding. If the site is drained appropriately, e.g. building french drains, this concern can be allayed. In general, the group recommended that the project proponents look for soft solutions for all of the erosion problems. Based on the Conservation Commission's recommendations, the housing proponents would have to come back with some modifications if the project were to move forward.

In terms of the stairway, everyone agreed that it would be approved, again, with recommending some modifications and noting some concerns: wildlife swallows in the cliffs, for example. It was suggested by the housing proponents that the bottom part of the stairs (at a minimum) be removable. This decision was reinforced when it was noted that the current (built in 1984) house owner and his family get down the bank by sliding or walking down it. Although the developers promised to remain in their house and never take a vacation, and furthermore, if

they did, their neighbor would take the stairs off, the group decided that it was probably a good idea to insist on partial or completely removable stairs.

In terms of the boathouse, not only was it withdrawn, no one approved it. Even if the boathouse were constructed on pilings it was not seen as something that was necessary. Once the boathouse was denied, there was no reason to have the groin that was listed as serving to protect the boathouse. There were a lot of alternative proposals, e.g. wooden structures, removable wooden boards, and so forth to allow the groin to be in place, but no one accepted that.

The planting of dune grass and installation of fencing, was not automatically denied. It was approved with some conditions, e.g. that wildlife habitat be taken into account to see whether or not the presence of dune grass was consistent with wildlife protection. On the other hand, the role playing owner of the 1984 house pointed out that he has never seen a bird walking through that sand area, and questioned the necessity of the review.

In terms of the seawall, this role playing group categorically denied it for everything except the two 1978 houses. Regulations grandfather this house allowing the seawall there in the first place, but it was strongly recommended that the current owners look into alternatives, a number of which have already been recommended. The housing developers in this working group had a lot of money. They were bringing three ton rocks in at the toe of the slope by barge and had tons of sand. Greenpeace, the role playing environmentalist, wanted twice the amount of erodable sand to be placed so that downstream there was satisfactory coverage.

UNIDENTIFIED VOICE ROLE PLAYING THE HOUSING DEVELOPER: I'm still willing to do it.

DR. PEDERSON: At the end, everybody decided they wanted to work with the developer. Another concern by most members of the group was the desire to maintain the quality of the neighborhood, as it is now. Even the realtor's perspective recognized the value of the neighborhood and did not favor the proposed developments.

MR. O'CONNELL: This situation is reality. Between the coastal processes presentation and the project proposal, this is the state of the art of coastal zone management, coastal landform management. I'm sure you all realize this is a real-life situation because you are all participants in coastal zone management in some aspect.

The purpose of this exercise was to open up our minds, play a different role than your routine daily position, and put yourself in a position to feel and think about a proposed shorefront development project from a different perspective. This project reflects components that we deal with frequently. There is no specific right or wrong answer. Coastal science is an inexact science, oftentimes requiring the coupling of coastal processes principles, site specific conditions, and professional judgment. The science has come a long way in recent decades.

We have 10 minutes. Do we want to continue this dialogue or leave now and continue the discussion on a more personal basis at lunch? We have so much talent in this audience right

now, that I suggest we maximize the few remaining minutes left and the use of this forum for questions.

MR. PESSOLANO: Hi. I'm Michael Pessolano, Town Planner from Harwich. It seems, in our discussions, that there was no realm of some comparability between values—the property owners' values and, obviously, the dollar value of their investment. But there are also other values that then went downdrift that were almost impossible to compare because there's no relative weighting of these values. The law seems to favor the pre-1978 homeowner. But is that to the disadvantage of the 1996 nestings of piping plovers? It's very hard to make public policy decisions absent that kind of weighting system for evaluating the merits. You know, in 50 years all this becomes different. But for this next 50-year period -- I guess that's what we're focusing on -- housing is only supposed to last 40 years in some people's mind, but the shoreline is constantly changing so where do you put the emphasis on the values is my question.

MR. O'CONNELL: It seems like the regulations do favor pre-'78 houses. That was really a political and a legal fairness maneuver on the part of those who had to promulgate the regulations. The scientists preparing the recommendations for performance standards for the coastal wetlands regulations actually suggested that all seawalls be prohibited if the physical system is to be maximized and protect everybody equally. But there was a fairness issue of protecting houses that had been built 100, 200 years ago, built long before we had a clear understanding of coastal processes, and long before the regulations. This resulted in the pre-1978 grandfathering for seawalls on eroding coastal banks. Economics and cumulative impacts are still something to this day that we don't have a handle on, quantitatively. What you did today in the development review exercise is what actually happens in reality. It's up to each individual to articulate their own values. If somebody wants to add to that, feel free.

DR. LEAVITT: We're actually going to be addressing the concept of values and cumulative impacts in the next exercise.

MR. O'CONNELL: Value and economics are going to be addressed in the exercise this afternoon.

DR. GIESE: Jim, there's a comment over here.

MR. HALL: Actually, another question. David Hall, Administrator for the Nantucket Conservation Commission. I'm two months into the job, so I'm very new at this. Something that we face and we've faced several times, I think we might be facing on a bi-monthly basis. The seawall as proposed in this exercise was proposed to protect the pre-'78 dwellings. In so doing and in so wrapping around, it may inadvertently perhaps have protected some other lots, maybe some other houses. To what extent can we restrict that sort of incidental, inadvertent, accidental protection? It seems that the pre-'78 proponents could well argue that a seawall needs to be quite large in order to fully protect their property. And in so doing, like I said, they can protect quite a bit more than just their house. There's a very, very gray area that we are facing.

A second question is, when is a pre-'78 dwelling no longer a pre-'78 dwelling in terms of additions to it? If you double it and triple it in size, if you move it over five feet, if you gut the entire thing and leave five shingles, does it remain a pre-'78 building subject to protection, or at what point can we say, okay, this is no longer what it once was?

MR. O'CONNELL: Are there any DEP legal attorneys here? I don't know what the specific answer to that question is. Questions like that are one of the reasons why we're here today: to exchange information and attempt to answer or brainstorm answers to complex questions such as that. When is a pre-'78 house no longer a pre-'78 house? When a house is relocated 50 feet landward, it's in a new location. Is it still pre-'78? I don't think there's a conclusive answer to that. (POST NOTE: A DEP Administrative Law Judge recently rendered an opinion addressing this exact situation in Docket #97-052, October 28, 1997.)

And to address your seawall statement, there is no absolute conclusive answer. But I think you know that there is an explicit prohibition in the regulations on armoring eroding coastal banks that are providing sediment to downdrift beaches and dunes where the armoring is proposed to protect post-August 1978 buildings. I don't believe -- and I could be corrected by the DEP folks here -- it's conclusive that you even have to permit a seawall for pre-'78 houses.

Alternative analyses are generally required because it has been shown that in some cases coastal engineering structures have had serious adverse impacts to other resources. I don't believe you have to permit it as a right, but that's my understanding of the regulations. If the seawall interacts with waves, consider also that where you end the seawall an impact may result downdrift. What already been suggested and some communities over the years have adopted is stopping the seawall not at the lot line but on the applicant's property some distance from the lot line and let the flanking erosion or end scour occur on the applicant's property and not the abutter's property. I believe Orleans may be one of the towns that has considered that technique. But the pre-'78 grandfathering must definitely be kept in mind and considered.

MR. WALTON: Russell Walton, Town of Chilmark, Conservation Officer and also a member of the Planning Board.

We had a very recent case in which we had a house which had been moved in 1975 [Ed. note: 1995]. And we were advised by DEP that a house which has simply been moved --and this one had to be moved in order to keep it from falling into the sea -- and not totally rebuilt might be considered to be still, quote, pre-'78.

MR. O'CONNELL: Just to add to that. I won't answer the question because I can't, but it's a fairness issue. Consider this: a seawall could be permitted in front of a pre-'78 house. But the owner decides they don't want to create an adverse impact to neighboring property, so they relocate the house landward. The bank continues to erode and years later the house is once again in jeopardy of loss but sufficient land no longer exists to relocate the house again. Should they be penalized now for doing the right thing initially? I'm not going to give my opinion

because it's a regulatory decision to be made by DEP, and according to Mr. Walton, DEP did give an opinion. I'm not sure if that would be the decision in every case, but it sounds to me that if a homeowner does relocate a building and it is not substantially improved, then I guess it would be considered a pre-'78 house. But again, it's a site-by-site analysis. If that's the decision that came out of the DEP, obviously, they spoke with their attorney.

MR. MAYBERRY GREENBERG: May I ask a question?

MR. O'CONNELL: Certainly.

MR. MAYBERRY GREENBERG: Allan Mayberry Greenberg, Scituate Conservation Commission. This is really for another one of the Conservation Commissioners, who, I think, has talked with you, Jim, about Holmberg's Undercurrent Stabilizer Systems for dealing with accretion of beachfront property, beaches. This person is currently coming up with a proposal for Humarock Beach. I'm just curious. I don't know very much about this, and I'm just curious if anybody has any experience with this technology.

MR. O'CONNELL: I did receive some information from the homeowner. Right now we're looking to see where it's been installed in other areas, and analyze the monitoring results, if there were any monitoring results. Obviously, if it comes from the manufacturer, I find that often times they will say that it has worked, and often times it may, but you've really got to put it in a site-by-site context. One erosion control technique may work in one area, and it may not in another. So I don't know if anybody else has any experience with the system.

MR. MAYBERRY GREENBERG: He calls it undercurrent stabilizer system. And the name is Holmberg. He's from Michigan.

MR. O'CONNELL: I'm not familiar enough with the system, particularly the monitoring results, to see if it was successful or not. Has anybody heard of the system?

(No verbal response)

MR. O'CONNELL: We'll get back to you.

MR. TAMSKY: Joseph Tamsky from Harwich. I think it would be interesting for some people to know that in the '90s of the last century, a landscape architect by the name of Charles Elliot, son of the President of Harvard, proposed that the Commonwealth acquire large sections or segments of the coast in Massachusetts and Maine for public area. If he had been successful in his proposal and hadn't died at an early age, perhaps none of us would have the problems we have today.

MR. O'CONNELL: It all comes down to funding. I think there are people along the shoreline who would like to be bought out because of the situation they're in. It comes down to limited funds. There is a grant program coming on-line that will be announced next month from FEMA that will include mitigation grant planning and implementation funds that will have an acquisition and relocation program to it. But even that fund is extremely limited, so it really comes down to available funds. Acquiring shorefront property for open space or recreation will certainly ensure that future hazardous situations are avoided.

MS. BALOG: Tina Balog, Brewster Conservation Administrator. This is relating back to our exercise, and specifically, probably the least consensus issue is the boathouse. And I'd like to listen to some of the regulators talk about whether or not this is really an activity you would permit in 1997 under our Wetlands
Protection Act Regulations. It seems to me that the dwelling would be a taking issue, possibly, but the boathouse is a totally discretionary issue. The way it was obviously designed it would not be a permitted activity in a barrier dune system, but I'm just curious about that.

MR. O'CONNELL: I appreciate your question, but I think that's probably a conversation that should take place over lunch. Often times you can look at plans, you can talk about proposals, but it's extremely important to go to the site, see it first-hand and talk to the people who know exactly what's going on in the area. Dunes must be allowed to migrate and reshape to the forces of winds and waves in order to maximize their beneficial functions. So, solid foundations are generally not in the best interests. However, in back dune, heavily vegetated, stable dune areas out of the flood plain, activities have been allowed that would not be in the active dune areas. So there really is no conclusive answer, Tina, but feel free to discuss this further at the lunch table. Can I sit with you?

DR. GIESE: Okay. Yes. Let's go to lunch everybody, and we'll be back here in an hour. Thank you for a wonderful discussion.

Managing Inner Shores
Sandy Macfarlane, Town of Orleans Conservation Commission

MS. MACFARLANE: Thank you, Graham.

Managing inner shorelines. As Jim was saying this morning, how do you manage the inner shorelines? Erosion is a natural process. We talked about that this morning. This is an attempt to try to put another spin on what we're talking about.

I think I'd like to start with the slides right away.

(Slide Presentation)

You already saw this picture of a satellite view of Cape Cod, but what Jim was talking about this morning is primarily the outside shoreline [pointing to outer shorelines of Cape Cod Bay and the Atlantic Ocean on the slide]. We'll call it Cape Cod Bay and outside shoreline. Interestingly, for Orleans anyway, when you're talking about shoreline erosion in Cape Cod Bay, a lot of the alongshore transport comes from the west, and a lot of it comes from Wellfleet on the north. It all ends up at Rock Harbor. We're not quite sure exactly what happens with all of that sediment, but that's about where it ends up.

We'd like to look at what happens on these inside shorelines, Pleasant Bay and the Nauset estuaries.

We have the undeveloped barrier beaches and although they are undeveloped, there still are problems with those beaches [slides of Nauset Spit]. They can breach, and there are overwashes when storms happen. When those storms occur, you have waves and wind that come at the exposed shorelines on the larger areas. Not that long ago actually, prior to 1991, there used to be 20 feet dunes here, but that October 1991 storm flattened those dunes. By flattening those dunes, there was a tremendous amount of overwash. This is in the Nauset system. Most people are much more aware of the Chatham breach because it was so spectacular, but no less spectacular, even though it's smaller, is the dynamics of this system, and it's changing on a daily basis.

This is tremendous habitat for the endangered species. We aren't allowed, at this point, to do any kind of dune restoration in this area because of that fact. And we have some problems. Most of the difficulty arises when the wind direction is northeast.

What happens in a storm? At the bank [slides of eroded banks], even if it's vegetated on top, there's going to be some scour on the bottom. This one happened to be protected, but this is the problem that we're facing, and I think that we had a pretty good sense of that this morning when we had some fun with what happens in these situations. To the homeowner, it's not fun. To the homeowner, they're looking at this bank that's in front of their house that is just disintegrating, and sometimes in one storm. Houses that are fairly close have been there for a while and they're probably pre-1978 [the date of adoption of wetland regulations]. We don't have to worry too much about some cases of the newer houses which were built further away

from the top of the bank. We still have a lot of worry about some of the older ones. Some of the banks are fairly steep and the houses really close to the edge.

From the conservation perspective, how do we handle these shorelines? The obvious answer for the homeowner is to do the hardest structure that they can find, because they don't want to worry about it, they don't want to do any sediment nourishment, bringing in sand. They don't want to vegetate a bank which washes away in the next storm; they look at it as throwing away money. They're willing to pay the big bucks to put in these big, heavy structures because then they feel safe [slides of shoreline structures].

Gabions are another method. We were told this morning by Jim that they may not be appropriate for outside shorelines, V Zones, but they may be appropriate structures for the inner shorelines.

Well, what will happen if we wall-in a town? In Orleans we've got probably two miles walled in right now. Most of Big Bay is reveted almost all the way around. There's a slight section that's out of the slide that is not. This is the only town beach on the Pleasant Bay side of town. Also, Harwich and Chatham each have a beach which means that except for Brewster all three major towns along Pleasant Bay have beaches.

We just heard this morning that if we have rock walls, then the beaches are going to drop, the sediment is going to disappear. What's going to happen with this particular resource, which we think is a very highly regarded resource for the townspeople? What's going to happen if this whole place gets walled in? What's going to happen to this beach? Is it going to disappear? How would we know whether it is or not?

Pleasant Bay now is the subject of a resource management plan for the entire embayment. For the first time, the four towns that share this body of water have gotten together to talk about the issues. Orleans has about two-thirds of the bay; Chatham has nearly a third and Harwich has a little piece over here, and Brewster has about 40 feet of shoreline but they have most of the watershed that goes to the bay. So they are as important a player as the people that have all the shoreline

What we're trying to do with Pleasant Bay is to develop a resource-based management plan for a host of activities. We will be starting with the resources themselves and then going to some of the human activities. How are we going to accomplish this?

Well, one of the things that we did was to look at the bay in segments. So with that, I'm going to go to the overheads.

I indicated earlier, that northeast winds were certainly important. This is kind of a busy slide, but what we're trying to do is to show how much of the shoreline of Orleans is affected by either north/northeast winds, the heavy storm, or south/southeast winds if we get a hurricane. Actually, some of the southeast storms that we get are pretty nasty, too. You can see that there's a tremendous amount of shoreline in Orleans that is affected here. The red is the velocity

zone (direct wave action), and the blue is the A zone, or flooding. Orleans is blessed with all this shoreline. Now we have to try and figure out what to do with it.

For Pleasant Bay, we divided the Bay up into smaller segments [map of Orleans with numbered segments]. We think that it's pretty obvious that Meetinghouse Pond up there, number one, is very different from number seven, Little Pleasant Bay. They just have completely different parameters in those two areas. For a lot of the issues related to the management plan, we needed to look at some of the human effects. What I'll be describing now is a method we developed to figuring out how we're going to deal with private docks. We are describing a scheme that will be resource-based that we hope will be defensible.

The second part was to look at each individual segment and describe it in words. For instance, Meetinghouse Pond is enclosed; it's not really open water. Because it's semi-enclosed, if there was a problem with flushing of the Bay, it would most noticeably be there. We looked at how many docks there were versus how many parcels without a dock and found that there is a low dock to parcel ratio. There's a lot of shellfish habitat producing some shellfishing in the area. There is a fringe marsh. There's some deep water. The pond is used for moorings and there's a lot of recreation going on. A lot of things are happening in Meetinghouse Pond.

We went through this exercise with all of the areas. We put these descriptive phrases in boxes on a matrix and said, well, okay, how can we really put these words into some other way? And we looked at the number of docks per parcel, parcels without docks, so we could get that kind of a ratio that could be described as intensity. We looked whether or not there was shellfish habitat and whether it was high or medium or low, and we looked at whether there was some fringe marsh, eelgrass, water depth, moorings, navigational channel, recreational use. To try to simplify the approach, we looked at all the resources or human uses as high medium or low. That gave us a better description of each area based on the resources and the human uses.

Then we looked at taking those words and putting them into some sort of a framework. Well, we're looking at biological factors; we're looking at physical factors, whether it's semi-enclosed or open water depth, those types of things; and then we're looking at the human use factors, whether or not there's channels nearby, whether there's moorings, whether it's highly used for recreational use. And then we tried to say, well, okay -- and we've had a lot of discussion about this one -- let's put a rating scale, let's put this numerically onto this framework that we've got. We were thinking of [a scale of] one-to-five, one-to-ten, something like that. Julie (Early, Cape Cod Commission) went back to a mathematician and she said, well, we're really looking at three things: high, medium, low. So why don't we just have three numbers. So we did. One is a high concern, .5 is somewhat of a concern, zero is low concern. We made it relatively easy.

Then we could put these words to the numbers [describing the matrix]. Yes, or heavy on that other scale that I showed you would be one. Slight or light would be .5. No or none would

be zero. Semi-enclosed or shallow would be a one because we just mentioned that that may have some of the higher factors. Semi-open, better exchange of water, .5; and if it's open or deep water, it would be zero. Heavy or great, all of these things we'd put in there.

Shellfish habitat was related to the state regulated shellfish species only, which historically, currently, or in the future could potentially support shellfish. That was a tough one, but we put that in. We considered each of those of equal value. Nothing was over another one. Yes, [meant] there's evidence to support shellfish; slight, [meant] support shellfish but not in heavy abundance; and no, [meant] has not shown any evidence of supporting any shellfish.

Fringe marsh, we were giving to the *Spartina*, mostly alternaflora, some patens. Heavy was a band that was 10 feet wide or greater. Medium was five to 10 feet. Light was less than five feet.

Number of docks to total parcels (ratio): greater than .5 was equal to one; .25 to .5 was .5; and less than .25 was zero.

Water depth, if it was deep, it was a zero. If it was shallow, it was a one. And moorings were within a 500 degree radius.

We looked at all of these things, and we said, well, okay, now we've got our number scheme. How is this going to work on the matrix? And what we think we're developing here is a sensitivity index. That's what our hope is anyway.

So we took all of the areas that we had, and I think there were 26 total areas, and we typed in the numbers, all across the board. And what we found out was that as we sort of intuitively suspected, the semi-enclosed areas that are in the upper regions of the bay have the highest sensitivity. These are the most sensitive. And they go up to some of the less sensitive areas. We never got anything less than a 2.5 nor anything greater than eight. You could possibly get a nine, you could certainly go down to zero.

Well, Graham asked me to speak today on landforms. We were thinking about this and trying to put our heads together. And we also had to address the landform/erosion issue for the Pleasant Bay Plan. We were falling short of our goal for the Pleasant Bay plan of coming up with a resolution of what we are going to do with these structures. We're just at odds. We're doing the same thing we did this morning. We'd go round, and round, and round in circles and just not getting off of this treadmill. And Julie said to me one day, well, why don't we do the same thing (that we did for the docks)? Why don't we put these variables in for the structures? Okay. So, we now have a set of variables that may or may not be important. And actually, your job today is to look at them and see whether or not they are important. Are these appropriate criteria to look at landforms and to look at the structures? Have we forgotten any? Should any of these criteria be weighted?

Now, for the docks, we went around and around and decided that really nothing should be higher weighted than anything else. Everything was on an even plane. Is that the same case for coastal banks? Is it the same case for the coastal landforms? Are there some criteria here

that are more important, and if so, why? So we went through this list [pointing to the list of criteria]. The width of the bordering marsh. Well, you know, we think that the marsh, even if the storm comes in the winter, that the marsh does break up some of the wave energy before it hits the bank, so is that an appropriate factor? There's usually a break between the edge of the marsh and the toe of the bank, some sort of a beach. It could be beach, it could be rocky, cobbly, but there's usually something there.

Is there some sort of a correlation between the distance that that is and whether or not a bank gets attacked badly, to put it in that vernacular?

Soil type in the bank itself. Does it make a difference when we're talking about unconsolidated sediment or whether we've got clay banks. You know, what does that have to do with anything, if anything? Is it an appropriate criteria?

The height of the bank. We were talking this morning. Jim was saying -- What was yours, 100 feet? Well, I'm not sure we have any that are 100 feet, but is the height of the bank really determining anything. Is it part of the erosion rate if the height of the bank is such and you get a 20 foot chunk taken out of the toe, does that erode the same 20 feet at the top or how does that fit the top of the bank? You know, all those types of issues.

Vegetated or nonvegetated. Is the bank scarp (phonetic) now or is it heavily vegetated?

Relative slope.

Compass direction. Compass direction goes along with that first map. Is it facing north/northeast, south/southeast, or is it going to be hit laterally as Jim was talking with -- sort of at an angle?

Presence of coastal engineered structure. Are there any there? How many are there to the total parcels? Can we do the same type of an analysis? How much shoreline is covered with those structures? Are there parcels that are covered with these structures that don't have houses on them? What is the distance of the house itself to the bank?

Is the bank subject to episodic storms or tidal action. In some cases especially for Pleasant Bay with the break in '87, a lot of this is just [a result of] this foot higher tide level. Is that something that's going to slow down as the beach grows south, and is it something we really have to worry about for a long period of time, or is it really the storm action?

What is the distance from mean high water to the toe of the bank? And what is the erosion rate, which Jim was talking about with the CZM maps? But the CZM maps don't necessarily give us what the erosion rate is on the inside shoreline because that was talking about the outside shoreline.

So here we go again. Is there some way of determining all these things? Should we ask a homeowner to determine them, or can we take this in a larger scale process and characterize a shoreline so that we actually get out of the case by case, property by property, type of issues that we were dealing with this morning? Is there some way that we can fit these two together? Is

there some way that we can look at an embayment, look at the historical aspect of it, look at all these factors, and then come up with some way of dealing with coastal structures?

As far as we know, we haven't heard of anybody thinking along these lines before. I'd love to hear it if they have. We don't know whether we're on the right track, but we figure that this is a good exercise for a hands'-on workshop like this. We want you to tell us what you think about this, whether you think that this is somewhat workable; and then what do we do with this information -- which we haven't gotten to yet -- once we get the banks and the shoreline characterized? How do we handle this?

I hope that this is going to be [fun] -- I'm sure it won't be as much fun as this morning, but I hope you can have some fun with this, taking a look at these criteria that we've set up, thinking about the way that we did it for the dock and pier issue, telling us whether we're on the right track for that one, too, and go forward and see what we come up with. This is one of those opportunities to just really brainstorm and say, okay, this is a different way. It's not from the regulatory structure. This is a whole different way of looking at coastal landforms on the inside shoreline.

And I know that I haven't taken up as much time as I was allotted, but I don't have any more, so if anybody else would like to ask me questions or whatever, I'd love to hear from them.

DR. GIESE: We've got time for questions.

MS. MACFARLANE: Jim?

MR. O'CONNELL: I'm not sure it's appropriate to do it now or in the breakout group.

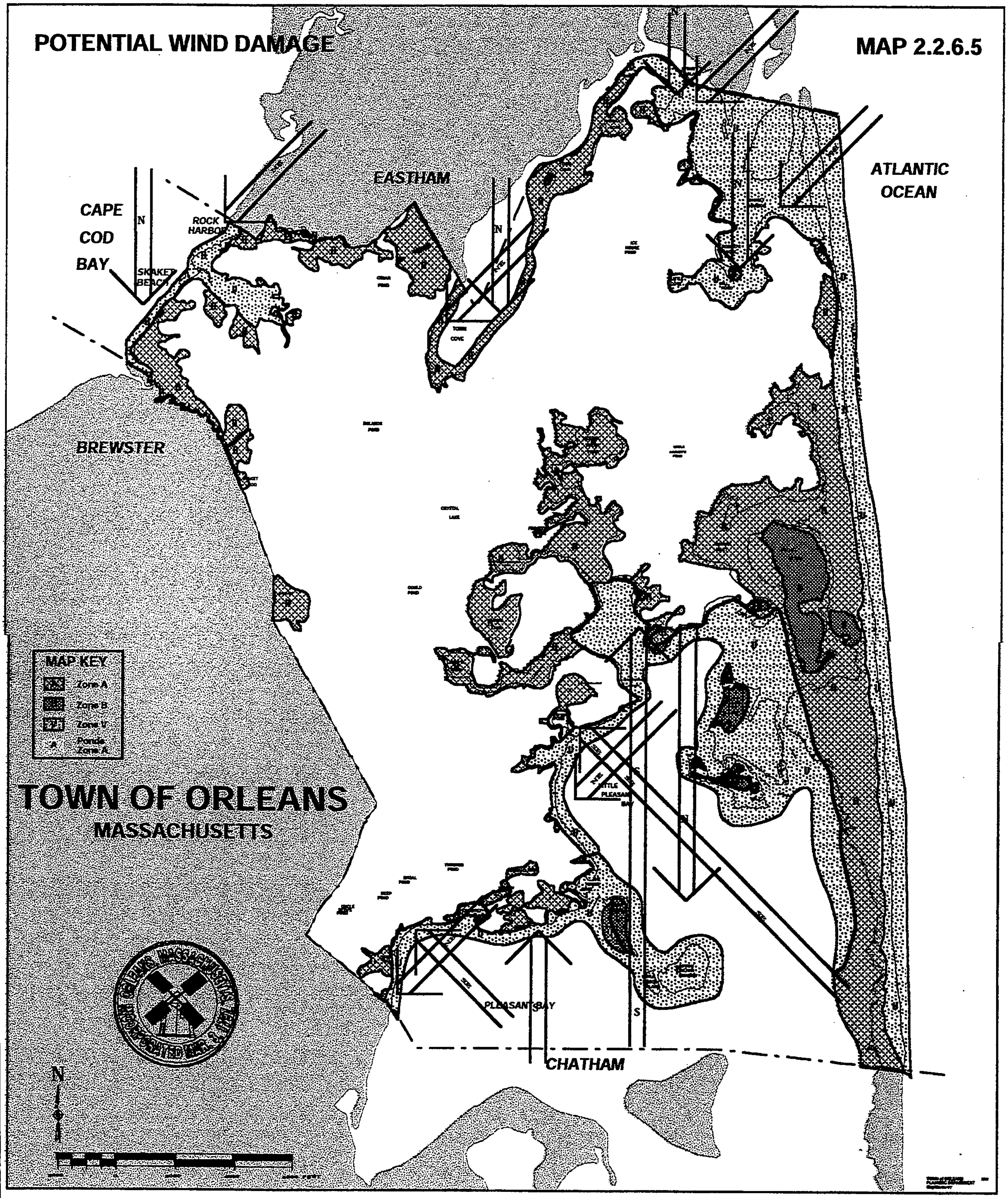
MS. MACFARLANE: I guess what I was wondering was whether people are clear on their assignment, so to speak, and, you know, have I gone too fast, or do you understand what I'm trying to get at?

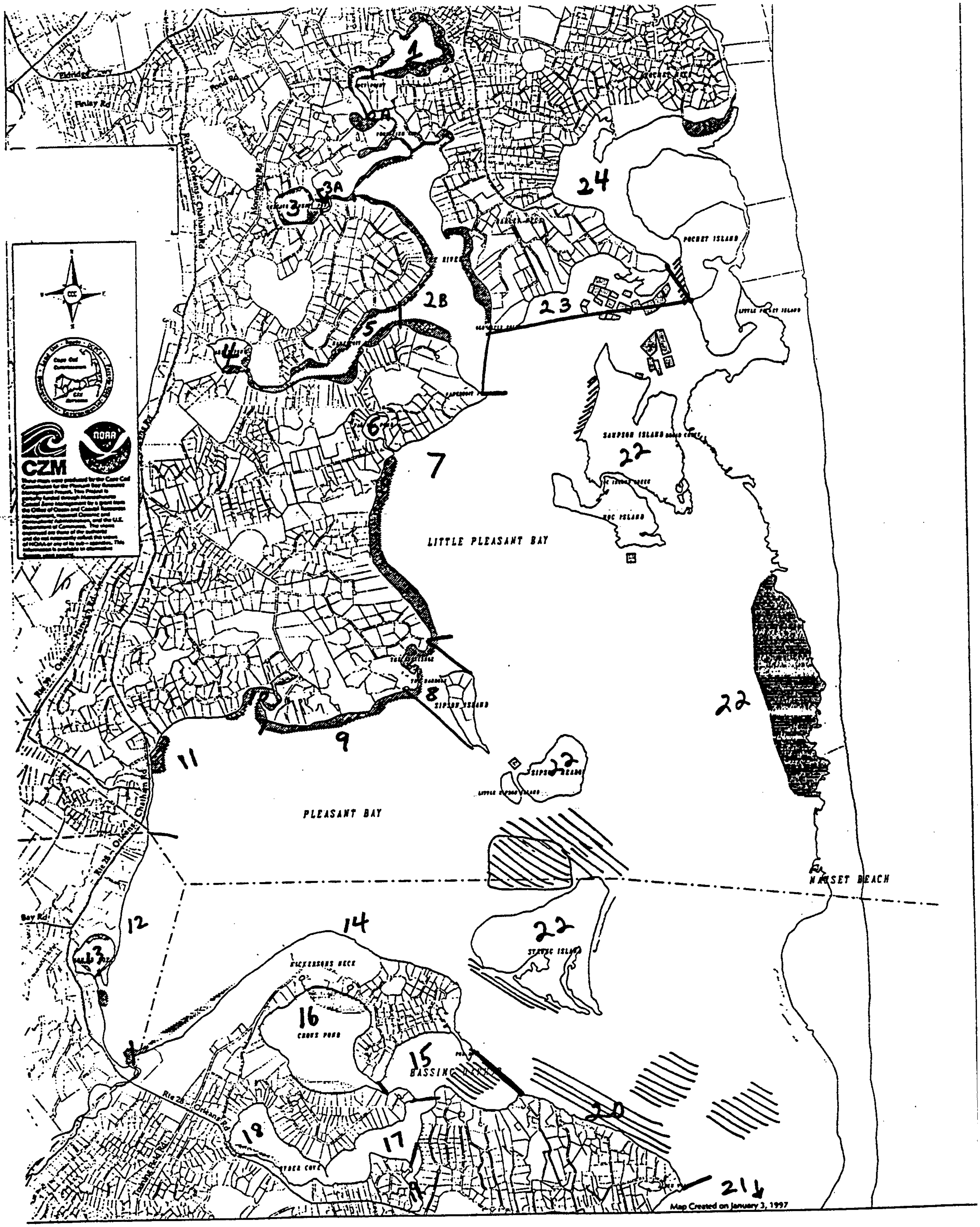
DR. GIESE: I think we do. I think from what I see around the room, I think we do. People are nodding their heads and saying, let's get at it. So thank you very much, Sandy.

MS. MACFARLANE: Tina was one of my teammates.

MS. BALOG: Tina Balog, Brewster Conservation Administrator. A couple of ideas. And actually, I want to let you know that this is your opportunity to help us set policy. This is really a very important aspect of the Pleasant Bay Management Plan. Obviously, you have an opportunity here to deal with Pleasant Bay from a system approach rather than by a lot-by-lot basis, which all of us have been extremely frustrated with over time. If you see a couple of variables that you might want to throw in that maybe aren't factored in. One of the things that related to the habitat -- the overall wildlife habitat issues that may be adjacent to your marsh or whatever, obviously should play a factor in here.

I kid you not, this is probably one of the more important exercises you may be involved in because it has broad implications. If our plan is adopted by the state, then it can be one of the things that we can regulate these areas a little bit more effectively as a unit rather than as an individual piece. So, I do implore you to put your best thinking cap on.


POTENTIAL WIND DAMAGE
MAP 2.2.6.5
CAPE COD BAY
ROCK HARBOR
SKAKET BEACH
EASTHAM
ATLANTIC OCEAN
BREWSTER
MAP KEY
Zone A
Zone B
Zone V
Ponds Zone A
TOWN OF ORLEANS
MASSACHUSETTS
LITTLE PLEASANT BAY
PLEASANT BAY
CHATHAM
N
S



LITTLE PLEASANT BAY
PLEASANT BAY
NAUSET BEACH
POCHET ISLAND
LITTLE POCHET ISLAND
SAMPSON ISLAND
SIPSON ISLAND
LITTLE SIPSON ISLAND
STRONG ISLAND
NICKERSONS NECK
CROWS POND
BASSING HARBOR
RYDER COVE
Rte 28 - Orleans-Chatham Rd
Rte 28 - Orleans Rd
Finlay Rd
Pond Rd
Bay Rd
CZM
NOAA
Map Created on January 3, 1997
1
2B
3
3A
5
6
7
8
9
11
12
13
14
15
16
17
18
20
21
22
23
24

EVALUATION OF COASTAL ENGINEERING STRUCTURES

Sandy Macfarlane
Coastal Landforms Workshop: WHOI Sea Grant, October 9 - 10, 1997

Variables	*Definition/Rationale for Using*	*Valuation*
Width of bordering fringe marsh		
Distance of landward marsh to the toe of the bank		
Soil type (consolidated/ unconsolidated, sand, clay, gravel, etc.)		
Height of the bank		
Vegetated/Non-vegetated		
Relative slope		
Compass direction bank/dune faces		
Presence of coastal engineering structures (number/total parcels)		
Length of structures along the shoreline		
Parcels with/without house		
Distance of the house to the bank		

EVALUATION OF COASTAL ENGINEERING STRUCTURES (continued)

Variables	*Definition/Rationale for Using*	*Valuation*
Bank subject to episodic storms/ tidal action		
Distance from MHW to the toe of the bank		
Erosion rate (CZM shoreline change maps)		

Inventory of Resource and Use Issues Relevant to Docks and Piers

Area	Number of Docks	Parcels w/ No Dock	Shellfish Habitat	Fringe Marsh	Eelgrass	Water Depth w/in 150'	Moorings w/in 150'	Naviga-tional Channel w/in 150'	Recrea-tional Use
(1) Meetinghouse Pond	11	32	Yes	Heavy	Light	Shallow	Heavy	No	Light
(2A) Kents Point - Upper River	18	10	Yes	Heavy	Light	Shallow	Light	Yes	Heavy
(2B) Kents Point - Namequoit	19	39	Yes	Heavy	Heavy	Shallow	Light	Yes	Heavy
(3) Lonnie's Pond	8	8	Yes	Heavy	Light	Deep	Heavy	No	Light
(3A) Lonnie's Channel	1	6	No	Heavy	None	Shallow	None	Yes	Heavy
(4) Arey's Pond	8	12	Yes	Heavy	Light	Shallow	Heavy	No	Light
(5) Namequoit Riv	16	32	Yes	Heavy	Light	Shallow	Heavy	Yes	Heavy
(6) Pah Wah Pond	6	7	Yes	Heavy	Light	Deep	Heavy	Yes	Light

Inventory of Resource and Use Issues Relevant to Docks and Piers

Area	Number of Docks	Parcels w/ No Dock	Shellfish Habitat	Fringe Marsh	Eelgrass	Water Depth w/in 150'	Moorings w/in 150'	Naviga-tional Channel w/in 150'	Recrea-tional Use
(7) Namequoit Riv - Narrows	4	31	Yes (slight)	Light	Heavy	Shallow	Medium	No	Heavy
(8) Narrows, Sipsons Is.	4	11	Yes	Light	Light	Shallow	Light	Yes	Heavy
(9) Bay/North	1	5	Yes (slight)	Light	Light	Shallow	Light	No	Heavy
(10) Quanset Pond	4	11	Yes	Heavy	Light	Deep	Heavy	Yes	Light
(11) Bay/Northwest	11	15	Yes (slight)	Light	Light	Shallow	Heavy	No	Heavy
(12) Bay/West	5	21	Yes	Light	Light	Shallow	Heavy	No	Heavy
(13) Round Cove	0	8	Yes	Heavy	Light	Shallow	Heavy	Yes	Light
(14) Nickersons Neck	2	16	Yes (slight)	Light	Heavy	Shallow	Light	Yes	Heavy
(15) Bassing Harbor	3	24	Yes	Heavy	Heavy	Shallow	Medium	Yes	Heavy

DEFINITION OF BIOLOGICAL, PHYSICAL AND HUMAN USE IMPACTS ON PLEASANT BAY (Revised 10/97)

Biological Factors	Physical Factors	Human Use Factors
Shellfish Habitat	Semi-Enclosed/Open	Ratio of Docks
Fringe Marsh	Water Depth	Moorings
Eelgrass		Navigational Channel
		Recreational Use

Overall Rating Scale Used to Evaluate the Above Factors

1 = High Concern
.5 = Somewhat a Concern
0 = Low Concern

Ratings for Specific Words:

Yes/Heavy = 1	Semi-Enclosed/Shallow = 1	Heavy/Greater than .5 = 1
Slight/Light = .5	Semi-/Open = .5	Light/.25-.5 = .5
No/None = 0	Open/Deep = 0	None/Less than .5 = 0

NOTES:

Shellfish habitat relates to all traditionally state-regulated shellfish (softshell clams, scallops, quahogs, mussels, scallops and oysters) which have historically, currently or in the future could potentially support shellfish. These shellfish species are considered equally of value. Yes = Has evidence of being able to support shellfish. Slight = Supports shellfish but not in abundance. No = Has not shown evidence of supporting or being able to support shellfish.

Fringe Marsh is the term given to primarily Spartina alternaflora with some S. patens areas.
Heavy = 10 feet or greater, Medium = 5 - 10 feet, Light = Less than 5 feet.

Number of Docks/Total Parcels = Ratio of Docks; Greater than .5 = 1, .25 to .5 = .5, and Less than .25 = 0.

Water Depth = Greater than 4 feet Mean Low Water, with shallow being a less desirable attribute.

Moorings and Navigational Channel: 500 feet radius from MLW.

PLEASANT BAY: SENSITIVE AREA DESIGNATIONS AND DESCRIPTIONS

1. *Meetinghouse Pond* is an enclosed pond on the upper end of an estuary. If there is a problem with flushing in the bay, it would be most noticeable here. There is a low dock to parcel ratio currently, with less than 25% of the parcels with docks, which means approximately 75% of the parcels could potentially each request a dock. It is a known shellfishing area close to shore (approximately 200 feet from fringe marsh) and beyond, which would coincide with the locations of potential dock placements. There is some deep water shellfishing here, but not in the fringe area. Fringe marsh may be found along the entire shoreline, while eelgrass is spotty, and the water depth is shallow (shown in bathymetry results). The pond is heavily used for moorings, it has no navigational channel, but is highly used by people coming and going for recreation. It is a busy place possibly due it's having both filling and pump-out stations.

2. *Kent's Point - Upper River,* which as a river makes the designation of enclosed versus open is a difficult one. It is a narrow body of water, where over 50% of the parcels have docks. This is a known shellfish area with a productive fringe marsh. There is spotty eelgrass, the area is shallow, moorings are medium density, there is definitely a navigational channel and is a busy area for its size.

3. *Kent's Point - Namequoit* is less narrow than the Upper River although it is very narrow around Mayflower Point. This area has a medium density of docks to parcels, and is a known spot for shellfishing, although some parts are not highly productive. There is fringe marsh in the majority of this area, although spotty in some locations, and it has a medium density of moorings, definite navigational channel and heavy recreational use.

4. *Lonnie's Pond* is definitely enclosed with a narrow channel leading to it. (This is a potential site for eutrophication in the future.) There is a medium density of docks to parcels, known shellfish habitat in the fringe and deep waters along the fringe, spotty eelgrass, deep water close to shore, heavy use of moorings, no navigational channel and heavy navigational use.

5. *Lonnie's Channel* is enclosed, narrow and shallow. There is one dock, some shellfishing in the river itself, fringe marsh throughout the channel, no eelgrass, and heavy recreational use from people coming and going.

6. *Arey's Pond* is similar to Lonnie's Channel and very active.

7. *Namequoit River* may be described similarly to Lonnie's Channel except that the channel is wider which provides more space for moorings.

AN ASSESSMENT OF BIOLOGICAL, PHYSICAL AND HUMAN USE IMPACTS ON THE SHORELINE OF PLEASANT BAY (7/97)

#	Section	Area	Enclosed	Docks	Shellfish	Fringe	Eelgrass	Water Depth	Moorings	Navigat Ch	Recreat.	TOTAL	*Ranking*
1	9	Bay/North Shore	0	0	0.5	0	0.5	1	0	0	0.5	**2.5**	Less
2	7	Little Bay	0	0	0.5	0.5	0.5	1	0.5	0	0.5	**3.5**	Sensitive
3	23	Old Field Pt	0	0	0.5	1	0.5	1	0	0	0.5	**3.5**	
4	21	Chatham Harbor	0	0	0.5	0	0	1	0.5	1	1	**4**	
5	11	Bay/Northwest	0	0.5	0.5	0	0.5	1	1	0	1	**4.5**	
6	12	Bay/West	0	0.5	0.5	0.5	0	1	1	0	1	**4.5**	
7	22	North Beach	0	0	1	1	1	1	0	0	1	**5**	
8	3A	Lonnie's Channel	1	0	0.5	1	0	1	0	1	1	**5.5**	
9	14	Nickersons Neck	0	0	0.5	0.5	1	1	0.5	1	1	**5.5**	
10	19	Frost Fish Creek	1	0.5	1	1	0.5	1	0.5	0	0	**5.5**	
11	20	Ministers Pt	0	0	0.5	0.5	1	1	0.5	1	1	**5.5**	
12	1	Meetinghouse	1	0	1	1	0.5	1	0.5	0	1	**6**	
13	3	Lonnie's Pond	1	0.5	1	1	0.5	0	1	0	1	**6**	to
14	16	Crows Pond	1	0.5	1	0.5	1	0	1	0	1	**6**	
15	8	Narrows, Sipsons	0.5	0.5	1	0.5	0.5	1	0.5	1	1	**6.5**	
16	24	Pochet Inlet	1	0	1	1	0.5	1	0.5	1	0.5	**6.5**	
17	4	Arey's Pond	1	0.5	1	1	0.5	1	1	0	1	**7**	
18	6	Pah Wah Pond	1	0.5	1	1	0.5	0	1	1	1	**7**	
19	10	Quanset Pond	1	0.5	1	1	0.5	0	1	1	1	**7**	
20	13	Round Cove	1	0	1	1	0.5	0.5	1	1	1	**7**	
21	18	Ryders Cove	1	0	1	1	0.5	1	1	1	0.5	**7**	
22	15	Bassing Harbor	1	0	1	1	1	1	0.5	1	1	**7.5**	
23	2A	Kent's Pt-Upper	1	1	1	1	0.5	1	0.5	1	1	**8**	
24	2B	Kent's Pt-Nam	1	0.5	1	1	1	1	0.5	1	1	**8**	Most
25	5	Namequoit Riv	1	0.5	1	1	0.5	1	1	1	1	**8**	Sensitive
26	17	Upper Ryders	1	0.5	1	1	0.5	1	1	1	1	**8**	

Biol., Phys., Human Use Values = 0, .5, 1

TOTAL (Sum) = 0 to 9

Reports from Breakout Group Facilitators

MS. MACFARLANE: Okay. In my roaming around, or roving, I guess, as you would call it, I noticed that people were having some difficulty with this issue. It was not fun like this morning, which I apologize for, and I think there was a little bit of thinking outside the box. I'm not going to say too much, but I would like to have my colleagues here summarize their thoughts on this whole procedure, methodology, and are we on any track at all.

I'll start with Judy.

DR. PEDERSON: I'm not sure if our working group understood this activity the least of all of the groups or were the most confused. We may have gone outside the bounds of the activity.

Because Sandy had given our working group a short presentation at the beginning of the session, it was clear that there were some very basic definitions, e.g. sediment scour and beach stability, that we really didn't know. This lack of basic knowledge set the stage for us and we asked, how do we deal with all of these issues in terms of trying to be more specific and quantify each variable.

One of the questions that arose was -- if you have erosion, does that mean that bank is a sediment source? Is that good, bad, or indifferent in terms of the context of our ranking scheme?

Having said that, I'm going to try to briefly summarize our responses. We approached this exercise by trying to give valuations for all items, although we did not finish. Thus, this discussion says something about many of the issues, but does not go into depth on any. I have attempted to highlight issues and identify definitions and rationale.

One of the topics discussed was how the height of the bank might be defined more clearly. One possibility was to relate height relative to a 100-year storm. For example, if the 100-year storm is 15 feet, an average height may be calculated as the basis for the valuation.

Another issue discussed was vegetated and nonvegetated valuations. The group noted that a different ranking system might be used in the A zone versus the V Zone. Solutions might differ, for example, vegetated areas may be preferred in one zone and not another.

Relative slope, presented the least difficulty. The working group set 1.5 as a middle value, with values being higher lower based on slope and assigned in the context of the larger picture.

Compass direction for the bank and the dune faces, may not be the variable to measure. The group thought it was more important to evaluate terms of the direction of the wind, e.g. running with the wind, or in that northeast/southeast quadrant. We set those two values and then identified a halfway value as 90 degrees within the northeast/southeast quadrant or directly facing the wind or halfway between it.

The presence of coastal engineering structures was given as number per totals. There were two perspectives: a microsite perspective and a regional one. A microsite perspective

takes into account what you have on either side of the property, e.g. nothing on either side, and it is assigned a value. If you have something on both sides, you might give it different values depending on whether you ranked it a high concern or low concern. A regional perspective looks at a larger scale, e.g. some distance from a site, and assigns a rank. It is not clear that just number per total parcels could be used alone.

The group suggested looking at length of structures along the shoreline, and converting that into a percentage. The question posed is, how much available open space or how much available shoreline structure did you have per linear footage within each of the zones that you were interested in? This approach permits development of a relative ranking for each of the different zones.

Parcels with houses and without houses were thought to be best dealt with as a percentage of what was available for that particular zone. The distance of the house to the bank was thought to be more related to the nature of the land with inclusion of information erosion from the surface. In a similar vein, it was suggested that a new addition to the list should identify parcels with houses and without houses, and perhaps redefine it for pre- and post-1978.

The final discussion of our group noted the confusion and frustration we faced in trying to develop a relative ranking scheme for variables which have such high uncertainty associated with them. Implied throughout the discussion and summarized at the end by the group is the caution that whatever valuation is used, it should be standardized as much as possible. Converting values to percentages is recommended as one option.

MS. MACFARLANE: Thank you, Judy.

Dale.

DR. LEAVITT: I started out thinking I had a very straight-forward path to follow, where I'd go through the list and we'd talk about them and add and subtract, and then at the end discuss whether it was appropriate. I had about one sentence out of my mouth before they deep-sixed that whole concept. So I'm going to try to follow through with the way the group's conversation went.

We started off trying to go through the list but we decided right up front that we needed more definition in terms of what structures we're talking about. Every set of structures has their own set of criteria or set of parameters that are relevant to that structure, so we realized right up front that that list was really mixing apples and oranges. Actually, we tried to break it down into two different categories: one of resource descriptors, and the second one defining what the impact potential was to the resource. From there we quickly realized that we had a real problem trying to convert qualitative judgmental-type information into some kind of quantitative analysis. Being a research scientist, I took great exception to one member's comment that this is a common fault of research in doing this. The truth hurts.

I did manage to finally get them to start talking about the resource descriptors themselves. We talked about those resource descriptors that more or less define some of the physical characteristics of the area, such as the width of the fringe marsh, the width of the unvegetated beach area, and the height and slope of the banks. We continued talking about some of the other resource characteristics, such as the sediment character and vegetation and fetch, and we realized that all of these were various ways of describing the erosion rate. Ideally, the group decided that they would like to see the erosion rate being the primary descriptor of those types of information. Jim O'Connell pointed out, we frequently don't have very much information on the inner shore erosion rates, so in that case you do have to resort back to vegetated versus unvegetated banks, sediment characters and other physical resource descriptors. There was considerable discussion about whether fines and silting is more of a problem on inner shores than it is on outer shores. Wind direction, fetch, storms, and tidal action are important but they all are, in some way, defined by using the erosion rate of the inner shore.

At that point I had to cut the conversation off because we had only 10 minutes left and what I really wanted to get to with our discussion was whether this was an appropriate means of looking at and evaluating the management approach for a resource area. It was suggested a few times during the course of the hour-long conversation that there has to be consistency between those parameters that are being measured or judged or quantified, and the current and/or future regulations that stand on the books. There are two different ways you can look at it. You can try to twist your evaluations to meet current regulations or you can set your evaluations and try to twist regulations to meet those evaluations capabilities.

I asked the general question, "Is this an appropriate technique?" I think it was clearly a yes. Our group thought it has a lot of potential but there are a number of problems that need to be resolved. One is that you have to be very careful and very clear about what your fundamental objectives are and what criteria you're using to look at these systems. Also you have to be very careful about what perspective you're using in making these evaluations. At one point we discussed looking at a two-axis matrix for each of the areas, where one axis would be the resource list, sort of Sandy's list; and the second axis would be what kind of structure type that you're going to be putting in that area. Well, we quickly realized that if you start listing structure types, it's going to be very dynamic and be changing almost on a daily basis as the technology changes.

What we did realize is that if you want to apply this kind of a technique, it really needs considerable discussion among people that really know and understand inner shore dynamics because you need that discussion to get this set right.

We finished up with a discussion concerning one thing that we really need to keep in mind at this point, namely that these types of lists serve as a guide and only a guide at this point. You can use this guide to give you some kind of indication as to how closely you must

scrutinize the proposed project within a given area, but in terms of using that as an absolute determinant, we didn't think that it was developed to a point where that could happen.

At the very end we started a discussion as to whether this was the right approach or whether one should approach it from the engineering side and define what resource area types are appropriate for the structures that are being applied. But that discussion didn't get very far because we ran out of time.

MS. MACFARLANE: Thank you, Dale.

MR. HENSON: Our group ranked pretty high on the confusion scale for this exercise. We did reasonably well at the first part of the exercise involving making sure that the list was complete. We added 12 or 15 more variables and decided that this spreadsheet would be rather massive by the time it's complete. In addition to the variables that were listed on the handouts, we added: wildlife habitat -- that is for endangered species, sediment sources, fetch, V or A Zone, shellfish habitat, eelgrass, near shore bathymetry, archeological significance, tidal currents, littoral drift, location within the drift cell, proximity to public resources, public access impacts, proximity to dredge sites, BVWs, and previous maintenance efforts.

We then, like Dale's group, actually went through and attempted to group these various parameters into three different groups: H (habitat), B (bank), and P (physical parameters).

This exercise was as difficult as we expected it to be in terms of defining values. We got about halfway through the original list while assigning values. As an example, in terms of habitat we determined that a width of fringe marsh between zero and five feet was comparatively insignificant; and five to 10 feet was deemed moderately significant; while 10 or more feet is most significant. In terms of the physical parameters, i.e. storm protection, zero to 25 feet was relatively insignificant; 25 to 50, moderately significant; and 50 and above, most significant.

We went through that same kind of exercise on a variety of these. We had some difficulty on a number of them. We finally decided that the intent of the category "Compass direction - bank/dune faces," was to define orientation to wind and wave action, and after about 20 minutes we decided that we would simply classify those as either significant or insignificant. Again, after considerable debate, presence of coastal engineering structures within 100 feet was determined as either significant, or not.

We were more productive in some of the other areas. Considering slope, we decided that 1.5 to one can be considered reasonably stable, obviously, depending on the material. So we decided that something 1.5 to one or shallower in slope would be of greater value than 1.5 to one or less. We talked about sediments and we broke that down simply to fines and coarses.

MS. MACFARLANE: Julie?

MS. EARLY: This exercise confused several members of my group and a lot of effort went into sorting out what the goals of the exercise were, how the matrix was formulated, and the ultimate application and use of the matrix.

The group decided to suspend judgment on the methodology and instead focus on the variables that were presented and determine if they were useful in the approval of shoreline engineering structures on the local, and if time permitted, regional levels. We agreed that the variables were on the right track in terms of what factors should be considered in a review. There was some discussion about combining some of them, such as compass direction and fetch, and episodic storms and erosion rates.

It was discussed that although this is a good planning tool for looking at development along the shoreline in a systemic way, we need to ensure that the method is applied consistently. There is too much potential for variation, and a need to increase the reliability and replicability of the method used.

We all agreed that the methodology chosen should be flexible to incorporate new information over time.

In looking at the specific variables for coastal engineering structures, we began with "width of bordering fringe marsh," which is important for breaking wave energy. "Soil type" is also important in relation to various habitats -- beach, marsh, and shellfish beds. "Height of the bank," "vegetated/non-vegetated," "relative slope," and "compass direction" were discussed as important in determining whether or not a coastal engineering structure might be appropriate in a particular area.

We did not want to place a value on the variables at this point, but focused on what variables should be considered when looking at engineering structures on a regional basis. Beyond the list that was provided, we added public interest factors such as recreational benefits/detriments, presence of archeological sites, and whether the house built before 1978, possibility for relocating the house.

As Sandy indicated, the Pleasant Bay Technical Advisory Committee came up with a matrix and method for reviewing docks and piers, and questioned whether the same method could be used to examine the regional, and system-wide impacts of coastal engineering structures. In looking at coastal engineering structures, perhaps the units which the Bay were divided need to be reevaluated and different criteria established to best understand system-wide impacts. But maybe the same divisions can be used.

Other variables my group mentioned, were shellfish resources, wildlife habitat, and proximity of the navigational channel. And basically, that's it.

MS. MACFARLANE: Thank you.

What I purposely neglected to tell you all, the punchline, is that I think we worked for maybe six meetings of two hours apiece to do the dock and pier criteria. Is that pretty close?

JULIE EARLY: Yes.

MS. MACFARLANE: We gave you an hour. So I think that what you folks have come up with this afternoon has been absolutely terrific. I thank you certainly, and I hope the other members of my group do thank you. Most of us are here.

This is an important exercise for us to try to deal with the structures on an embayment that is shared by four towns. As I said earlier, it's the first time four towns have actually gotten together to talk about these issues. Hopefully, we will end up with something that will be adopted by the four towns and that we can really take a look at engineered structures and erosion on inside shorelines and actually come up with some way to manage them.

So, I think without any further comment from me, I'm just going to throw it open to the audience and have any questions or comments.

DR. GIESE: Well, Sandy, can I also say it was suggested to me that we also open this last 10 minutes to comments or questions about the day as a whole.

MR. HALL: Since no one else got up, I say this at great risk, and I say this with very little experience. This is coming from a place where our local by-law says no coastal engineering structures, period.

But the sense that I got from the exercise was looking at a regional area and assessing the question -- the premise was where are coastal engineering structures most appropriate? The thing that we are struggling with on Nantucket is that the presumption is not where are they most appropriate; the presumption is that they are not appropriate anywhere for many of these reasons we discussed. On a very, very site specific, case-by-case basis we will evaluate them with a degree of reluctance and largely because we're driven to do so by the pre-'78 grandfathering provision of the Wetlands Protection Act.

But given the relative lack of development on Nantucket, I think we are perhaps in a slightly different category than a more developed area where you are confronted with the reality of you've got a lot of pressure to do something about this problem that we call erosion.

I guess to sum up what I'm saying, if I can possibly do so, is that I was somewhat troubled by the approach of let's mark on the maps where we should sort of categorize -- which areas would you categorize as possibly appropriate for coastal engineering structures? I would be more comfortable with, certainly from my perspective, of the presumption of they're not appropriate anywhere unless an applicant comes forth with a very, very compelling argument and reason for the placement of the same.

MS. MACFARLANE: Could some of the criteria that we were developing serve that purpose, rather than mapping an area, having the applicant look at these criteria, or having the Commission look at these criteria once you've got it all set up to determine, in fact, whether or not it was appropriate. Can it work that way?

MR. HALL: Yeah, I think it can, but I guess I'm struck by a site visit the Coastal Zone Management made to Nantucket last week, in which several -- Rebecca Haney and I think Jim may have come out to take a quick peek as well. And we had very little time. This was unscheduled. But in a three minute look-see -- maybe it was five minutes -- Rebecca outlined to me maybe 10 very, very salient points about the conditions of the site. She basically, in her mind, with her experience, went through this exercise that we were trying to put down on paper.

With that experience, she gave me, as a lay person, a very -- I think a very, very good sense of what the parameters are for consideration. If I were to, as a lay person, plug in the variables of that site into a matrix, first it would take me a great deal of time to do that, but also it would -- every step of the way would require a judgment call on my part. And every time I, as a lay person, am forced to make a judgment into a mathematical equation like that, it really increases the risk of error by the time you do the full computation. Having someone like Rebecca or, I think, most of us in this room, go out to a site and evaluate it based on our experience, based on our knowledge of coastal processes, I think in fairly short order, we can come up with a very, very defensible, sound, reasoned approach as to whether a particular structure is appropriate or not. I think the matrix approach -- I've used it in other cases myself -- I think there are very appropriate times for that.

My sense is there are so many variables in here that it does them a certain injustice to try to fit them into the spreadsheet because it's hard to consider everything. For instance, width of bordering fringe marsh may be very, very narrow and, therefore, according to the matrix, we may value it less. Well, the reason why it is narrow may be because it's been degraded, maybe because of other activity in the area has caused a degradation of that area, caused that once very wide fringe marsh to become very, very narrow, and because -- And for that reason we should be very, very careful about trying to restore that area. Whereas, in the matrix, it would just get a little mark because it was narrow, and we would lose a whole bunch of information in the process.

MS. MACFARLANE: Thank you.

MR. MONCEVICZ: I'm Don Moncevicz. I'd like to be the devil's advocate for Nantucket, okay? You said none of these hardened structures, okay, but if you have a harbor, and probably the answer there is yes, the Steamship Authority wants to do something, bring passengers in. It's already developed. Boston Harbor. It's already there. They come in, it's already there, it's fixed, hotels, everything. And so that gets approved.

But the residents on the south side of Nantucket with a house on a coastal bank, no. No hardening. That's not fair, is it? That's not fair. The Steamship Authority, the big developers in Boston that have all the resources, the engineering consultants, the lawyers; "Joe Homeowner" doesn't quite have that, a much smaller scale. Not fair. I'm just trying to be the devil's advocate.

MR. HALL: May I respond to that?

I totally agree, it's not fair. I'm not sure that that's pertinent to the discussion at hand, if whether the matrix -- a matrix -- the use of a matrix is appropriate for decision-making. I agree. That's not fair and that needs to be addressed as an equity issue.

May I ask another question of Jim? Jim, you said earlier that in one of your opening comments, or as you were closing your opening statement, something to the effect that when we armor a coast, we put the problem off for future generations to deal with. Is that sort of an accurate paraphrasing of what you may have said?

MR. O'CONNELL: No. I think I said that in context of setbacks.

MR. HALL: Of setbacks. Okay. Well, I guess my question is this. If we do allow armoring of one sort or another, if we do interrupt the coastal -- natural coastal processes to one degree or another, and then we take them out because they're not working, or the storms take them out, does the coastal process then just -- does the natural succession of the coastal processes just continue at the same rate at which it would have continued had we not interrupted the process, or in interrupting the process, are we taking greater risk? Are we causing a shortening of the beach and a steepening of the bank, such that when the system goes, if the system goes, there will be a much more dramatic and destructive event than had we not done anything at all.

MR. O'CONNELL: I hope I can get your question answered correctly. Yes, if you think of the coastal system, it's in an equilibrium based on winds, waves, tides. There's an equilibrium profile based on all the natural parameters. When you interrupt that equilibrium by putting in a seawall, for example, if that seawall fails, the seawall, for example -- Let me give you an example. I'll give you a concrete example, actually. The dewatering system on the eastern shore of Nantucket. The dewatering system has forced the natural system into a different equilibrium, into an equilibrium based on the dewatering system. It's an erosion control system. There's a new equilibrium where the system is working. The electric system of the pumps have failed frequently in the system. When they fail, it goes back to the natural equilibrium, it goes back to the natural equilibrium very quickly, and yes, you will have generally a catastrophic event, particularly if you have a hardened structure landward of that, like a house.

So, you know, you're forcing the profile, and as long as you can continue forcing that profile, maybe you're okay.

A coastal engineering structure on a bank, when a storm hits, the banks that are not armored will be providing sediment. That sediment is going to make that whole beach system, on severe cases, ultimately as much as a 30 foot bathymetric contour. It's in the system. But you've got this void of sediment coming out of the bank so that now you've got sand moving in the system, but you're going to have almost like a scallop effect as you move down the system. If your house is landward of that scallop effect, your house is going to be more severely impacted than it should be if that structure -- than it would be if that structure were not there. Did that answer your question?

(Mr. Hall nods head.)

DR. GIESE: That's a fascinating discussion. It's getting toward 4:00 o'clock, and we have time for one more question.

MS. BALOG: This is back to the matrix, and I think maybe you're misconstruing what the purpose of the matrix really is. I think that one, obviously the matrix is being used to make decisions, not to be definitive and say, oh, you know, if we get a 9.5, it's appropriate. I think it

can be used to identify areas that might be more -- well, areas that have -- where structures could have little to no impact. I think that's going to be very rare. I really do.

I can tell you that the issue that you identified as fringe marsh being less than 10 feet, we know through our work with the regulations that any competent biologist, engineer, any site assessment work that's done, you could overcome those -- presumption of those definitions or those criteria in the matrix. So, again, I think it's being used -- A lot of us here are much higher level professionals than conservation commissions would be or members of those conservation commissions would be at knowing what are all the parameters that we should be looking at, just period. And I think that will help to bring those issues forward to the table a lot more often than if the engineer who does a really good job at wooing them with a few things. I think that's what it was really intended to do, is bring about some uniformity in the review process, because you're dealing with four Conservation Commissions in a specific area.

We've been talking about having a Bay plan or a Bay manager that would monitor the projects that go forward in each one of these four towns, and I think that's a good idea. I think it's a necessary idea, but I think that, again, it's a way of building a tool box for the people who are looking at these projects.

And I don't think it's really meant -- I hope it's never used to say, ah, I had a score of a 9.5, therefore I win. I hope that isn't the case. But I agree that a lot of us have been lied to with numbers, or the numbers have been twisted to suit the case. And, oh, you know, my house is at 50 feet. You know, everything is at 50 feet. Well, that doesn't mean that that other 50 feet back from the coastal resource area does not have significant value. I think we are all faced with that when we have setbacks that we've worked with in our local by-laws. Everybody designs to that setback. And I imagine that because of what we're trying to do, we will probably see that happen. It's just a fact of life, unfortunately. It's human nature.

DR. GIESE: We have a final word?

MR. WATSON: Okay. Just a quick one. Jim Watson from the Old Colony Planning Council. This thing has three quick points. One is there's a human instinct to meddle, and we like to change things and build things. And I think what I take from Jim's presentation is almost that we should be passive, which isn't what you're saying, but that such a stress on deposition and erosion that I -- and I'm aware of the issue on the South Shore, but I keep thinking it would be good if further discussions could graduate that and you could comment on what you commented on conversationally about certain beaches that are equally -- because they get recharged, re-extended seasonally versus one which requires continual littoral movement of sand.

And then I think if there could be a little time in getting some common language on just the tools for better or worse, you know, the fact that a concrete seawall is apt to tip over, and riprap might settle, does or doesn't absorb energy, you know, what a geo -- What is that, geo-soft bank?

UNIDENTIFIED VOICE: Geo-tube.

MR. WATSON: Thank you. Yeah. And, you know, there's a number of things. Somebody else had some literature about a system that trapped sand in suspension and doesn't let it escape. And I think, in a way, if there was maybe 15 to 20 minutes just on some of the terminology, even if some of these ideas are very bad ideas, we should know what they are, and a little more sense of the graduation of what the sensitivity is in different areas. So we're aware, you know, what bluffs can be preserved. Are we going to have -- Are we going to live in Kansas eventually, totally flat. A couple of responses. Thanks.

DR. GIESE: Thanks very much for that discussion and all this discussion. This is exactly what we came here for today.

Friday, October 10, 1997

Welcome

DR. GIESE: Good morning everybody. Welcome back to the second day of our workshop. It's wonderful to see everybody this morning and appreciate the early rising that we all did together.

It's kind of a full morning, and I don't want to, in saying "morning," neglect in any way the afternoon. I do hope that as many people as possible will be able to stay for the summary/ discussion after lunch. We'll try to put together input.

Speaking of input, I think everyone received evaluation forms at the registration table. Please get one if you didn't, and please try to remember to turn those in. They really do help. The feedback really helps the program here.

Another announcement has to do with this first topic this morning. According to our agenda, the breakout group discussion starts at 9:00; it will be a little later than that. We're also going to stop it a little early, too, so that the panel discussion can be longer. So the break will still be at 10:30, but don't be surprised if the breakout group ends their discussion a little before 10:00. Jay's going to add some special material during the panel discussion.

I mention Jay. I'm talking about Jay Tanski who is the Sea Grant Coastal Processes specialist from New York Sea Grant and a friend from long ago who's agreed to come and present our third topic this morning, which is Managing Altered Shores. Welcome.

Managing Altered Shores

Jay Tanski, New York Sea Grant Institute

MR. TANSKI: Thank you very much, Graham. Could I have that first slide, please?

(Slide Presentation)

MR. TANSKI: Well, I'm not sure why Graham wanted someone from New York to come up and talk on the topic of managing altered shorelines. As you can see from this slide, New York really has relatively pristine, natural, undeveloped shorelines. At least in the eyes of a New Yorker it's a pristine, undeveloped shoreline.

What I'd like to do today is give you a very brief tour of Long Island so you know where I'm coming from, touch on some of the management philosophies employed there, and then talk about a particular problem we have in a place called Westhampton Beach on the south shore. I believe that's going to be used as a basis for your breakout discussions today.

Believe it or not, not all of the Long Island shoreline looks like this. For those of you that haven't been there, New York's open ocean coast is about 135 mile stretch of coastline. It stretches between New York City out to Montauk Point over here. Actually, Staten Island does have an ocean coast, but I'm not going to discuss it here.

If you look at this coast, it's relatively short compared to what you have in Massachusetts, but it is fairly diverse in terms of the types of shoreline forms you see there and the level of development along the coast. If you go out to Montauk Point in the east, you have high glacial bluffs very similar to what you have on Martha's Vineyard and on the outer Cape. Geologically speaking, it's almost exactly the same as what you have out on Martha's Vineyard, and I believe on Nantucket also.

In terms of development, the east end bluffs of Long Island are characterized by very low density residential, almost rural, development.

That's the Montauk Lighthouse. Some of you might be familiar with this structure. Apparently designed by George Washington, it was built 200 feet inland so it would last for 200 years, based on the erosion rate. The Corps of Engineers is now starting to make George Washington a liar by putting in a structure here to preserve it.

As you move further to the west, the bluffs give way to low headland area that's fronted by barrier beaches. This is the famous Hamptons area of eastern Long Island. Development is characterized primarily by very large mansions sitting on large estates, so you really have low density residential development.

You move further to the west, and you come to the barrier island system. The Long Island shoreline is characterized by some 90 miles of barrier islands and spits. They extend from Southampton, all the way into New York City. They're quite diverse in terms of development. Some of them are totally undeveloped. We have an eight mile stretch of wilderness area, part of the Fire Island National Seashore. We have some areas that have, I'd

say, low to moderate density development communities, primarily single-family homes that are seasonal in nature. This is one of 17 communities found on Fire Island.

As you move closer towards New York City in the west, you find the barriers are used intensively for recreation. This is Jones Beach State Park. It's on Jones Beach barrier island. It receives some seven million visitors per year. More people go to the beach at Jones Beach State Park than go to see Niagara Falls every year. It's the most used state park in New York.

And just to give you an idea of the size of it, this is just one of seven parking fields they have. They've had 275,000 people visit there in one day. These are cars up here to give you an idea of the scale.

And then, of course, as you go further in towards the city, you have a highly urbanized coast. You can't even tell that this is indeed a barrier island. This is Coney Island. And there's been so much infilling you can't see the original configuration or back barrier bay.

Although the shoreline is altered, New Yorkers still like to go to the beaches. You might say this is a degraded beach, but New Yorkers go to beaches like this in droves. This is a picture of Coney Island. Literally millions of people visit the beaches in New York every year. The beaches are a very important recreational resource for them. As a result, the beaches are also a very important economic resource to New York. And just to give you an idea of how important they are, back in 1988, we had a medical waste wash-up scare. Some syringes and other medical debris washed up on the beaches, receiving a lot of publicity. People didn't want to go to the beach, they didn't want to go in the water, they were afraid of getting sick.

Whether the public perception was right or wrong is beside the point for this discussion, but economists found that because of the drop in beach attendance, there was a $1.4 billion loss to the regional economy on Long Island. So, although you might not believe it, New Yorkers do like the beaches, and the beaches are very important to the recreational and economic aspects of life in New York City and Long Island.

So what is happening with the beaches? This slide shows how the position of the shoreline has been changing from Montauk Point in towards the city over the last 100 years. The areas in red are areas that are eroding. The areas in yellow are actually areas that are accreting, where the shoreline's moving seaward.

And what you see when you look at these data are some very interesting trends. First off, for the most part, the south shore of Long Island is eroding at a relatively low rate, usually less than one to two feet per year. And that's kind of within the margins of error that we have for measuring that type of thing.

Another interesting thing that you note is that we have some areas that are actually relatively stable or even accreting, as you can see here. Not too many of them, but we do have some areas, at least over the 100-year time scale, that seem to be relatively stable.

The third thing you note that when you look at this information is that the largest shoreline changes occur in the vicinity of the inlets. We have six inlets that are stabilized for

navigation on the south shore. I have three of them marked on this map. This is Shinnecock, Moriches, and Fire Island. And when you look at the data, what you see is that there is a characteristic trend. I'm going to switch the slide here. This just shows the shoreline change rate for a shorter time period. It shows this trend a little bit better. You see there's a characteristic trend where you have accretion on the east side of the inlet, and then erosion on the west side. Moriches, you can't really see it because we don't have any data for the east side of the inlet, but you can see the erosion on the west side. At Fire Island, you can see this trend very dramatically with high rates of erosion on the west side and accretion on the east. This is primarily because the net transport of sand along the south shore of Long Island is from the east to the west, and these inlets interfere with this transport. They disrupt the natural flow of sand. Here you can actually see it at a place called Shinnecock Inlet, which is an inlet that's furthest east on Long Island. And you can see, this is the east side of the inlet, the shoreline has prograded seaward. You have a lot of sand accumulating here and in the bay. Then you have erosion occurring to the west. This is very characteristic of all of the inlets that we have on the south shore.

Now, what's being done about erosion. There are a number of different alternatives or options you have for erosion management as far as protecting upland areas; but basically, all these alternatives can be grouped into three categories that you see here: management techniques, nonstructural erosion control techniques, and, of course, the hard structures that are used to combat erosion.

By "management techniques," we usually mean laws and rules, regulations and ordinances, that try to prevent development in coastal erosion hazard areas. And in New York we use all three of these erosion control strategies. We're relying more and more on the management techniques and the nonstructural techniques, but we still do use structural erosion control techniques, and you'll see why in a few minutes.

In 1981, New York passed the Coastal Erosion Hazard Area Act, and that regulated new development in areas experiencing erosion. This law required setbacks for new development in what they called coastal erosion hazard areas or natural protective areas, which were defined as dunes and beaches. It also provided provisions for structures that had to go in these areas. These provisions included maximum footprints and requirements for easily moveable foundations.

All the coastal communities on Long Island, except for two, participate in the National Flood Insurance Program, which provides building codes for structures that are going in flood areas. They also provide for coastal zoning ordinances that try to keep development out of areas that are prone to flooding or erosion. So, they are using these management techniques to the extent possible. Here's a house going in being built to FEMA code.

The problem that we find with the management techniques is they're really only good in those areas where you have no development now or where you have new building. They're not so effective in these areas that have already been developed.

Now, obviously, it's going to be very difficult to try to retreat from the sea in a situation like this. Areas where you have structures that can't be moved either because of the nature of the structure or because you have no room for relocation are problematic. Where are you going to move these people? You have to start looking at other erosion control alternatives such as the nonstructural and the structural erosion control measures.

New York is moving towards beach nourishment as one of the favored nonstructural erosion control measures. This is simply pumping sand to build up a beach, which can be used for recreation and provide protection for the upland areas.

Here you see a dredging project. They're dredging an inlet, Fire Island inlet up here and pumping the material down to build up a beach on Jones Beach. This beach will be used for recreation and it will also provide protection for the parkway that you see here.

Now, beach nourishment works fine in certain areas where you have low erosion rates. It doesn't really do anything about the cause of erosion. You're simply building up the shoreline. It might not work so well in those areas where you have a high degree of development and very high erosion rates. It's not economically feasible to keep a beach in those areas. So in those areas, New York has used structural erosion control methods to try to supplement the nonstructural erosion control techniques that are used.

One of the structural erosion control measures that has been used quite extensively in New York is the use of groins that you see here. These are structures built perpendicular to the shore. Now, in most cases, these structures were put in in the '20s or the '30s, before there were environmental and coastal management laws. In a lot of cases, these structures would not be allowed now, but New York is considering the use groins in some of the new projects that are being proposed. They have been found to provide certain benefits.

This is a 50 foot groin field in Long Beach that was put in the '20s. I would submit that if these groins weren't here, the development is still going to be here because, as you can see, this is a highly urban area. If these groins weren't here, you would not see the beach here. They've done a decent job at slowing down the erosion rate enough that they can maintain a beach, but they can't be used everywhere, as we'll see in a second.

Now, most homeowners can't afford, for technical and economic reasons, beach nourishment projects or those large types of groins that you see, although some people on Long Island can afford those. What the homeowners usually opt for, which I think is what you're probably seeing here, are the shore hardening structures—the bulkheads, the seawalls and the revetments, such as you see here. And it's kind of interesting, there's a lot of controversy about the use of these structures, primarily because of the impact that they can have on the beach. I'm not a proponent of these structures by any means, but we do have certain situations, I would

say almost unique situations on Long Island, where these structures have been used and haven't had an adverse impact on the beach, and that's primarily because of the unique nature of the sites that we have on Long Island. Studies have shown in those areas that are relatively stable over the long term, at least over the 100-year time frame, that the structures prevent erosion of the upland when there is short term-erosion caused by storms. In these cases, we find the storms come in, cause the erosion, and expose the structures. After the storm recedes material comes back to the beach, often burying the structure. It's very important that you have an adequate supply of material in the area.

And we do have situations on Long Island where these structures can be put in. When a storm comes and removes the beach, they provide protection for the dune and the upland area. After the storm recedes and material starts coming back in -- I apologize for the dark slide, but you can see this is the same house shown in the previous slide. After the storm recedes, material starts coming back into the area, the beach builds up and essentially just buries the structure and the structure has no interaction with the beach or the beach or waves. However, that's a relatively unique situation, and in a lot of cases, we have areas which are experiencing long-term, chronic erosion and then you see this type of situation. So, for the most part, the use of a shore hardening structure, especially on the south shore, is being discouraged, except for in those very few unique areas that are relatively stable but experiencing short term storm-induced.

So just in the way of summary, in New York there is no one overriding coastal management philosophy for the entire south shore. Rather, the policy and the objectives to meet that policy are developed on a reach-by-reach basis, and they're based on the processes acting on the shoreline, the way the shoreline is responding, and the specific use of the shoreline or the intended use of the shoreline.

I think this is important because there is no one size fits all coastal management policy that's going to work for all areas. You really have to look at the site specific conditions. So that's what we're trying to do in New York.

All right. Now, on to the case study. And this is where you really have to listen because you're going to be tested on this.

The area I'm going to be talking about is called Westhampton Beach. It's on the south shore of Long Island, and it's between Shinnecock Inlet to the east and Moriches Inlet to the west. The island itself is a 15-mile long barrier island with moderate density development, primarily single-family homes. Certain parts of this barrier island are experiencing very, very severe erosion. You can see the severity of the problem, for instance, right here. In some areas, the erosion rates are as high as 20 feet per year, and it's causing problems for some of the homeowners. As a matter of fact, the erosion is so dramatic, we've made the national news. This is an article that was in *Time* magazine some time ago, showing Westhampton Beach. And although, if you can read the headline, it talks about nature taking its toll, that's not really the case here. There are other factors besides nature that have at least contributed to this problem.

To really understand how this problem came about and the situation at Westhampton Beach, you have to go back to 1938.

We had a very severe hurricane. I believe the '38 hurricane hit up here pretty hard, too, but it was very bad on Long Island. It's the storm of record for Long Island. It actually punched a hole through the barrier island in an area just east of what is now called the Westhampton Beach, which is right here. Here you can see this hole. This is the ocean, this is the bay. This hole became known as Shinnecock Inlet. The fishermen really liked it because it provided access to the ocean. A big fishing facility was built next to it. They liked the inlet so much they stabilized it with jetties so they could safely navigate out to the fishing grounds.

And as we discussed, once you stabilize these inlets, they start blocking the natural transport of sand. And that, indeed, happened right here. You can see that the sand started piling up here, it started getting lost in the inlet, and erosion rates on the Westhampton barrier island to the west increased dramatically.

If you look at the historical records what you found is that before Shinnecock Inlet was open, the historical erosion rates were something like 1.2 feet per year along that whole stretch of the beach. After the inlet opened, they jumped to eight feet per year. The inlet was stabilized. They remained at eight feet per year for a while, and then they went down to about four feet per year, which was less, but still significantly higher than the natural background erosion rate of 1.2 feet per year.

So the erosion was pretty severe there and people were getting concerned. Here you can see the offset in the islands at Shinnecock Inlet again. The Corps of Engineers was called in the '50s to see what could be done to alleviate the problem. And the Corps actually came up with a fairly reasonable plan. They said, what you should do is just replace the sand that's been lost. Pump sand on the beach and monitor it, watch to see what happens. Then if you start losing it too fast and you can't afford to maintain a beach with pumping alone, you can think about using structures such as groins to hold this artificial fill in place.

But if you build these structures, and it's a big if, what you have to do is start at the western end of Westhampton Beach, at the downdrift end by Moriches Inlet. Remember, the alongshore transport is from the east to the west. The Corps said to start building these groins at this end, fill them with sand, and work your way back to the east. That way you won't disrupt the alongshore transport. So they had a nice plan, it was all bound up and sat on everyone's shelf for a while.

Then in 1962, we had the Ash Wednesday nor'easter. This was a big nor'easter that hit the northeast coast, caused a lot of problems on Long Island. One of the things it did was punched another hole just about through the middle of the Westhampton barrier beach island. Here you can see the breach itself. Well, people immediately panicked. No one even bothered to look at all at the reports about what should be done. Rather than using the fill as the Corps had

recommended, there was a big outcry by the local people about the immediate need for groins. We can't afford to mess around and just put sand on the beach.

So they started building groins immediately. Well, they made a few mistakes. First, they built the groins in the wrong place. They built 15 groins over a period of about five years, starting in 1965. This is the last of the 15 groins which you see right here. Now, if you remember, the Corps said, first, you should just put fill in, but if you're going to build groins, make sure you start up at Moriches Inlet. Well, they kind of missed the mark a little bit and started them well east of Moriches Inlet as you can see here. So they put the 15 groins in. Even worse, after they put the groins, they claimed they did not have enough money to fill the groins with sand, so they just let them fill up naturally from the material that's moving along the shoreline. And the groins did a great job of trapping that material. The groins trapped about five million to seven million cubic yards of material. The people behind the groin fields loved this, of course. They had nice big dunes and wide beaches. Unfortunately, although the people immediately behind the groins were well protected, the people immediately west of the last groin did not do so well. They were on the downdrift end. In other words, they were on the other side of the dam where the water had been stopped. Because they lost all the sand that would normally get to their beaches, their erosion rate went up to, as I said before 20 feet per year.

It caused some problems, as you can see from the shoreline here. In this portion of the barrier there were about 250 homes. Further to the west, there was also a large county beach and recreational facility. They lost the road. This is the water main that used to be buried five feet under the road that provided access to the houses and to the beach down there. These people were not very happy about this, and they brought a lawsuit against the federal and county government for $250 million.

There was a lot of controversy about what should be done. Everyone had their own pet theory about what the best alternative, the best option for dealing with it was. As you can see from these headlines, there was not a whole lot of agreement. So, Sea Grant immediately, of course, jumped into the middle of the fray. We decided that we would try to bring some unbiased information to the people that had to make the decisions about what should be done here. And so we convened a panel of national experts. We were lucky enough to have Graham, of course, participate in it. We asked these experts to come in and take a look at the various options that were available for dealing with the Westhampton Beach problem. We didn't say, tell people what to do. We charged the group with looking at the various options a technical prospective in terms of their feasibility, cost and, the potential benefits and the disadvantages of each one.

We looked at six options that had been proposed for alleviating the problem at Westhampton. They ranged from doing nothing to a highly engineered solution involving construction of breakwaters and other devices. And what I'd like to do now is just kind of step

through the options and the advantages and the disadvantages so you have some background to work with.

The first option that we looked at was, of course, the do nothing option. This is a favorite in New York because you have no initial cost and no one has to do anything. The panel did point out that there were several disadvantages of trying to employ this option in Westhampton. First, if you didn't do anything, you'd expect this accelerated erosion to continue. As that continued, not only would you lose access to this section of the barrier, you'd start to lose houses. Eventually, what you'd see is the barrier becomes so weakened that you would also see inlets forming through here.

Now, the inlets were a concern for a number of reasons. One, modeling studies had shown that if you have a new inlet forming here, you could actually increase the water level elevations in the back bay area. Since you have $275 million worth of development already in flood prone areas in the back bay, you're only going to increase the threat of flood damage to that $275 million worth of development.

They were also concerns that you would change the hydrodynamic and environmental characteristics of the bay. You'd expect the salinity, temperature, the shoaling patterns to change. That could have some impacts on the biological resources and especially the shellfishing resources in this bay. So there were concerns about that.

Another thing that you can expect to happen with this type of erosion is, over time, the whole barrier island to separate from the groin field. This would cause some damage to the $144 million worth of development that was behind the groin field.

Another problem if you created a new inlet, is that it would rob some of the tidal flow from Moriches Inlet, which was about 2.5 miles downdrift of that erosion area. And if that happened, you'd start to see the inlet shoal in, which would cause navigation problems for the commercial and recreational boating interests.

Another option that was looked at was pulling all the groins out, allowing things to go back to the way they were before the groins were installed. The estimated cost was about $12 million. That was based on a Corps study that was done in 1984. The advantages of this type of option is, of course, that you would release that five to seven million cubic yards of sand that would move down the coast and help repair some of those beaches that were damaged. Of course, you'd increase the erosion rates in the groin field since you're removing that protection. Eventually, you would start to see those four foot erosion rates along the entire barrier island again, and that could lead to the formation of inlets in a period of about 15 to 20 years. So you'd be dealing with some of the similar issues that you were dealing with in that one section west of the structures.

You'd also see increased shoaling at Moriches Inlet. If you release all this sand, you'd expect the sand to move west to the inlet. That's a problem with all of the alternatives so I'm not going to mention that anymore when we talk about the alternatives.

Another option that was looked at was burying the groins and moving the shoreline out past the tips of the groins by adding sand. The cost would be about $55 million to bring in enough fill to extend the shoreline out past the ends of the structures. But you'd also have maintenance costs of $2 million per year. These are just estimates we made from back of the envelope calculations based on the best available information. Of course, by moving the shoreline out past the groins, you would lessen their influence on sand transport and you'd build up a wide enough beach that would provide protection for the bay and the upland area. You could also use that beach for recreation. And if you didn't like what was going on, you could just walk away and the shoreline would erode back to its original configuration. You're not doing anything about the processes causing the problem. You're not building any structure, you're just putting sand on the beach. Disadvantage? You would have a long-term commitment, because you aren't doing anything, you'd expect the erosion to continue. There is also a great deal of uncertainty about how the shoreline would respond once it got back to the structures; how fast the erosion rates would be, and how much you'd really have to be putting in in terms of maintenance.

Another option that was looked at was shortening or modifying the groin field by tapering it. And by tapering it, we simply mean either building new groins that become progressively shorter or taking the last few groins and shortening them up so you ease the transition between the groins, which are here, and the original shoreline. It's thought that this can actually increase the amount of sand transport past the groins.

This would cost anywhere between the cost of pulling out all the groins and about $40 to $50 million, depending on how many groins you had to put in and how much fill you needed. Advantages? Once again, you could hopefully re-establish that transport of sand along past the groin field. You could reduce the maintenance by reducing the impact of the groins. The groins won't be causing as much erosion so you wouldn't have to put as much sand onto the beaches. And you could also provide some protection. The beach would not be quite as wide, but you would be providing protection for the bay and the upland area. Disadvantages? This option has never been done anywhere in the world before, and that's why I could only show you a diagram rather than a photograph of the tapering. No one had ever tried it, so it's very experimental and you don't know exactly what's going to happen when you start pulling apart the groins, especially within the groin field. Well, you would have reduced protection, you would have a smaller beach. Because it's experimental, you're going to need a lot of time to study it and, of course, by increasing the sediment transport, you're going to cause problems at Moriches Inlet.

Another option that was considered was extending the groin field, putting in the rest of the groins called for in the original plans developed in the 1950's and then filling them with sand. This option is estimated to cost about $75 million. You're looking at $20 million for the 13 groins. Remember, these groins are about 500 feet long. They're not small, insignificant

structures. The advantages of this is you are going to have a high degree of protection. You know the groins work, you have a full scale model. You know the groins work where they were already placed. You know they do not lose much material. They are actually sinks for most of the material that came into the area. None of it ever got out. You would have a very wide beach that could be used for recreation. And if you fill the groins, you could re-establish the sand transport. The major disadvantage is you might be translating the whole erosion problem downdrift, so you're going to have to be very careful about what you do at Moriches, and make sure you have some mechanism for by-passing the sand from one end to the other.

Now, the last thing that we looked at was to construct a breakwater. I don't know how many of you are familiar with breakwater structures. These are rather large structures that are built parallel to the shoreline and offshore. They operate by breaking up the wave energy before it can reach the shore. They're used a lot in Japan and areas where they have a very, very high value on coastal land. They're not used so much here. This is the most expensive option. We were kind of underestimating here, saying those structures would cost $5,000 a foot. They're probably more like $10,000 a foot. So you're talking a cost well in excess of $75 million. We couldn't really estimate that because we'd have to do some studies to see what kind of structures would be needed.

The advantages are these structures can be designed to do a lot of different things. They could be designed to provide a high degree of protection for the beach, the bay and the upland area by maintaining the integrity of the barrier island. They could be designed to hold sand on the beach, and at the time, maintain alongshore transport of sand while you reduce the offshore losses. They could also provide recreational beaches, as you saw in that slide I just showed you.

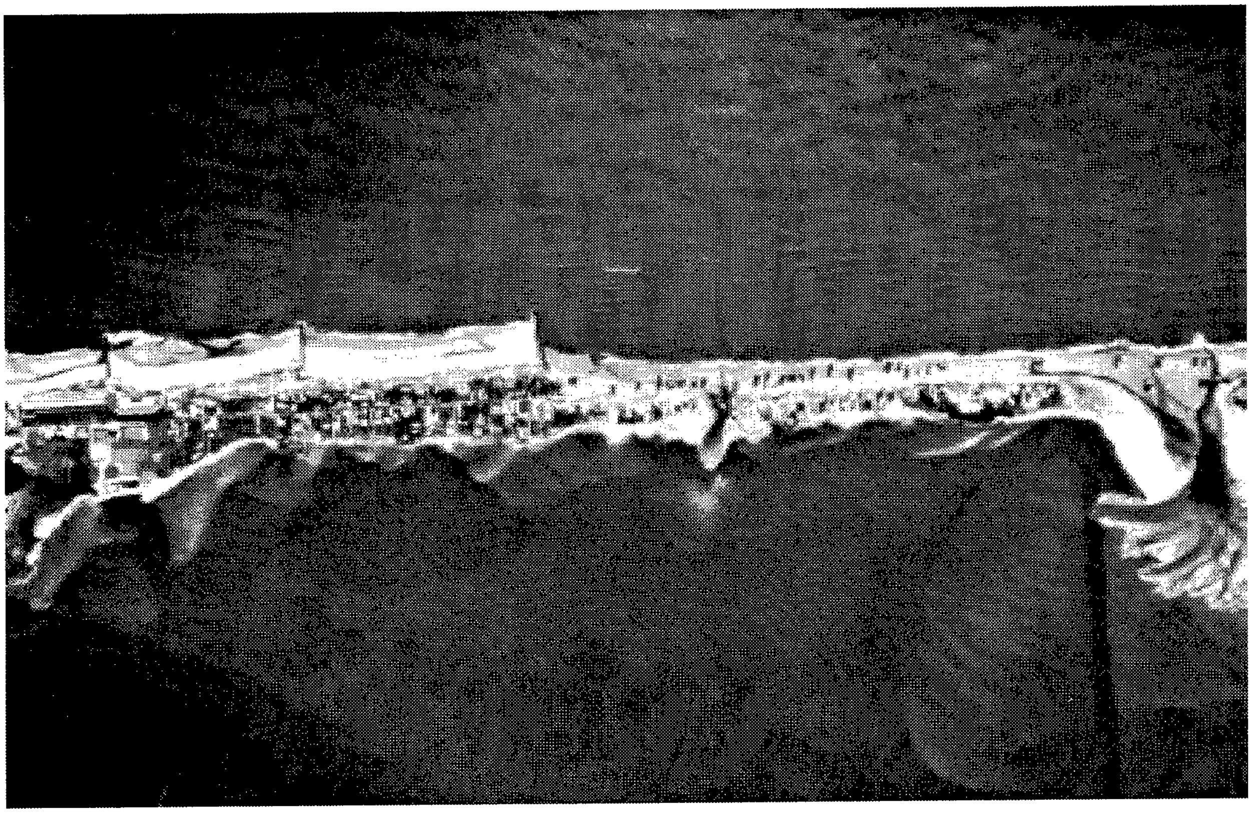
The disadvantages are if you miscalculate with these structures, you're in big trouble. They really take a great deal of study and a lot in the way of design. You have to have a lot of physical information about the site. I wouldn't say they're necessarily experimental, but you have a high degree of risk when using this option. If you do it wrong, you could cause some major problems. There's also aesthetic issues, of course. It would take a lot of time to do the proper studies to put this type of structure in. And you also have the initial cost. It's the most costly of any of the alternatives that we had looked at.

And I believe that's where I am going to end and where you are going to have to take over.

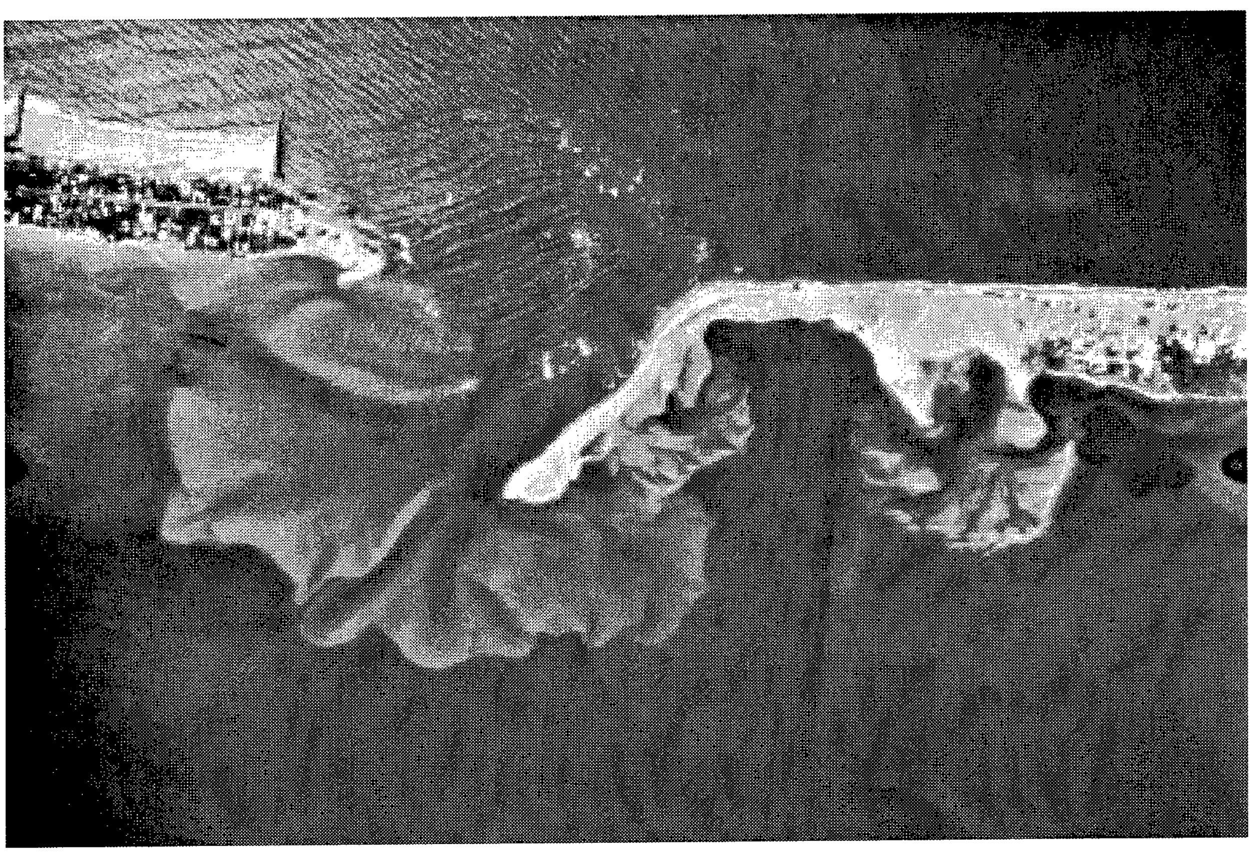
DR. GIESE: All right. Thanks, Jay. Well, we will. We'll break up into the same groups. Everyone has their groups, and we'll just follow the pattern from yesterday. We'll kind of fold the break into this. I think that's a good idea so you can be getting coffee as you debate and so forth, so don't worry too much about that time.

Photos provided by Jay Tanski, New York Sea Grant

Erosion downdrift of groin field, Westhampton Beach, Long Island, NY.



Photos provided by Jay Tanski, New York Sea Grant



Erosion downdrift of groin field, Westhampton Beach, Long Island, NY.

Reports from Breakout Group Facilitators

MR. TANSKI: I guess what we're supposed to do now is we'll go through the different solutions the panels came up with, the different groups came up with, and then I'll provide you with what the New York solution was to it. And I guess we'll start from this end and work our way down.

DR. PEDERSON: The discussion began with the group looking at all the options, the costs, and identifying the issues that we felt were important relative to where we expected to go with the discussion.

The group recognized this is a dynamic system that on its own changes over time; it is not static. We attempted to get a sense of how to build the dynamic nature of the system into our expectations. A specific example of the dynamic nature was the changing erosion rates over time. Initially, it was one to two feet per year, and then after the groins were built, it went to eight, and back to four. The erosion rate has never returned the one to two feet per year initially observed. This suggests that there has been a change in the whole system, and the focus should be from a broader perspective.

The working group decided that the criteria for making a decision was that it should not create havoc for the houses that already existed in the flood plain, both on the barrier beach and behind it. The options that we considered were: (1) to make the groins permeable (based on Jim's presentation yesterday); (2) to shorten the groins along the eastern most edge; (3) to extend the groin to the western edge and also to taper them; and (4) to include the beach nourishment project because you have so much erosion.

The group identified the need to calculate a mass balance for the sand, and to consider by-passing the Shinnecock Inlet so that you continue to have the sand coming into the system.

DR. LEAVITT: We thought it would be an interesting exercise to start the discussion where cost was not a factor but we quickly decided that the cost is probably the primary driving issue in terms of what gets done. We came up with a scenario where cost was a factor. I'll defer telling you about that discussion now because it turns out that it was our best scenario in the end.

I'll start off with just quickly going down through the list of action options. We concluded that if we did nothing, the overall cost was very low initially but because of potential bay impacts and loss of property in the long term the cost was going to be way too high. One point that was noted was that we didn't really like the numbers that were generated in the report. We thought there were many hidden costs and unidentified factors that were not accounted for and these hidden costs were directly applicable to the actions that we were trying to accomplish.

We talked about beach renourishment and thought it was an option. We could have the initial cost picked up by federal, state, and local funding agencies and the subsequent annual

renourishment costs somehow be passed on to the homeowners. You know, if there's 250 or 300 houses along the beach, it comes to somewhere around $5,000 to $8,000 per house for beach renourishment.

Another option that we explored and many in our group were fairly enthusiastic about was dredging at both of the inlets and then using that source material for beach renourishment.

To cut to the chase, our best scenario was to modify the existing groins. We thought a good first cut would be to look at reducing the groins by 50 percent of their length because they're way too big and too long. Fortunately, we have Jim O'Connell in our group so he informed us that there are ways to model what happens structurally on the beach with different groin fields. We could try some model testing to determine what would be the overall impact of reducing the existing groins.

Using the stone material that was pulled out of the existing groins during the reduction in length, we would continue to build a groin field downfield to Moriches with the overall lengths tapering down, if the models indicated that this was an effective way to resurrect the beaches below the groin field. We proposed to saturate the groins with sand as they were constructed and annually renourish as needed.

Finally, it was pointed out that federal money was supporting all of this activity. Therefore, we had to make sure there was beach access for the general public when we get those beaches back.

MR. HENSON: Our findings were almost identical to the others. We ended up with a combination of shortening and tapering at least the westernmost three or four groins, building additional groins between the westernmost groin and Moriches Inlet. Also, mechanically transporting sand across the mouth of Shinnecock Inlet to increase the amount of sediment into the overall system, dredge Moriches Inlet and use material from there to nourish and add additional nourishment from an offshore site or otherwise to fill the new groins, if not to capacity, at least approaching capacity.

We also have no idea of what the cost might be, but we suspect that the lawsuits would be so horrendous if nothing was done that the cost would be insignificant.

MS. EARLY: Thanks. We had several outstanding questions and funding was a major concern. Who would pay for all of this? Should this be a consideration?

We discussed how much erosion was occurring west of the Moriches and questioned whether we should be concerned about Fire Island and the impacts our decisions would make on this community, or maybe we should think that it is a separate problem and we do not have to deal with it here.

The group also questioned the source of the sands for renourishment, the availability of sediment and costs involved in obtaining the necessary supply.

Other issues that were raised included: the need to dredge at Moriches Inlet or bypass Moriches Inlet to minimize erosion of the beach and impacts on Fire Island, help minimize shoaling, as well as in the inlet.

In regards to tapering the existing groins, the group reviewed the potential impacts before deciding to use the Army Corps of Engineers report as a guide, while questioning how much faith to place in the report.

The group also explored purchasing all of the property at Pike's Beach. How much would it cost to purchase the 200 houses? Probably too costly to consider.

The group did not come to complete consensus on what actions to take, but the majority chose to extend the groin field, include beach nourishment, and the use the Army Corps of Engineers' report as a guidance document. There was some debate about whether to take the groin field out altogether or to instead taper them. One person felt that beach nourishment should be the only form of remediation.

MR. TANSKI: That's very good. As a matter of fact, you were all very close, except for the first option that New York took was to do nothing for awhile. Could I have the first slide.

Then, our hand was forced once again. In 1992, we had the December 11 storm and, as the panel predicted, two new breaches occurred in the area downdrift of the groin field. This is called Little Pike's Inlet, and the bigger one was further to the west.

This is an aerial view of the inlets. You can see the groins here. This is the big inlet. There was a dredge that happened to be working in the back bay area, and the local interests were concerned about this big inlet, and so they actually had the dredge come in and, for about a $100,000, they filled the inlet and plugged it up.

The small inlet, Little Pike's Inlet, which they thought would close naturally, started growing. At first it was so small you could walk across it. It kept growing reaching a growth rate of about 27 feet per day. Here you can see a house that was washed back into the bay area here. You can see there's also quite a loss of sediment to the bay here.

Finally it got to be about 2,200 feet wide, about 20 feet deep, and people went, hmm, maybe we should do something. They lost 170 of 250 houses, and obviously, it was a little bit difficult to get to the county beach over there. There were some measurements taken and the predictions of the tidal range increasing in the back bay areas were indeed true. It increased by about 35 percent. We're only talking about a two foot tide there, so you think, ah, what's 35 percent. That was a problem. When you look at the mainland area, you get an idea of how low it really is, and we had one situation where areas were flooding that never flooded before. A house was burning, fire trucks were trying to get to it, it was a spring high tide. They could not get to that house because the road was flooded. The paper headline said, House Burns to Waterline. That's not something the local government officials like to see happening in their district.

So a decision was made to do something, and the Corps was called in and they initiated an $8 million project to close the breach. They started by building a steel coffer dam structure across the inlet and bringing in fill. In the next few photographs you can see they're working their way across inlet.

And, in October, almost a year after the breach opened, they finally closed it with 1.1 million cubic yards of fill. Now, this was just a stopgap measure. They figured that this could withstand a five-year storm.

In the meantime, the judge in the lawsuit that the homeowners brought against the federal and county government said to the government people, you're going to lose this lawsuit for $250 million. You better try to settle out of court. And so the Corps of Engineers, working with the State of New York, came up with an $80 million interim plan for the area. The plan itself involves bringing in fill to build up the beach area. I think the initial construction costs for the whole thing were $50 million; $30 million for the maintenance costs. But they brought in fill to build up the dune to 15 feet. Here you can see a before picture, and that's an after picture. They built the dune up 15 feet high, the beach is at an elevation of nine feet, and about 100 feet wide. They figured that would provide protection for a 30-year storm.

Another interesting component of their interim plan is that they decided to remove the ends of the last two groins that had not filled completely anyway and build a structure in between them to try to taper the groin field and restore the alongshore transport to this area.

And here you can actually see them doing this. This is the next to last groin. There's the last groin. And they started working here. They were trying to take them apart. They had some problems. They found out they couldn't really take the groins apart very easily because they were out in the water. So what they had to do is come in and bring in more fill and bury the groins and then dig them up and then take them apart. So it got a little bit complicated, to say the least. But eventually, they were able to remove the tips and build a new groin in the field.

There's a little curve that I didn't tell you about during the talk because I didn't want to make it totally complicated. Because of lawsuits that were brought back in 1977, I believe, and a decision by the Council on Environmental Quality, the Corps was not allowed to work outside or build any new structures outside the footprint of the original groin field until they decided on what they were going to do for the south shore of Long Island from Fire Island Inlet to Montauk Point. So they couldn't go outside the field, and that's one of the reasons they decided to go with this tapering approach here.

They still don't know how it's going to work. They did some modeling, but they don't really have the data they need for accurate modeling, so they're supposed to monitor it and see what happens.

And by 2002, they say they'll come up with a long-term plan, and that will allow them to look at all the options that we looked at.

In the meantime, you can see some of the redevelopment taking place in this area. They're starting to rebuild some of 170 houses that were lost. If you went down and looked at it now, that little dot is this new house shown here.

UNIDENTIFIED VOICE: What's the total number of houses that are left?

MR. TANSKI: Well, there were 250; 170 were lost over that period of time, so you're talking about 80 houses were left. Mostly down on the end. There were more problems than you thought because that whole area was cut off and they were having problems, believe it or not, with vandalism. People would come over with boats, I guess kids, and they would go into the houses and just wreck them. So even the houses that weren't destroyed by the natural processes were destroyed by vandalism. And they had, of course, that county facility which was totally lost for that period of time. Now, they do have a road and there is access to the county beach.

MR. PESSOLANO: Michael Pessolano from Harwich.

What made the decision-makers believe that cutting back on the groin field wouldn't just shift the problem further east and scour the new area?

MR. TANSKI: Further east or further west?

MR. PESSOLANO: Further east. Wasn't the sand coming from the east going west?

MR. TANSKI: The sand comes from the east. It's traveling in a westward direction. But you're saying if they cut back the groin field --

MR. PESSOLANO: They took the last two groins out --

MR. TANSKI: Right.

MR. PESSOLANO: -- which would then move the problem further east.

MR. TANSKI: Well, you would have less protection. But they did not touch the other 13 groins, and what was happening, as you saw in those pictures I showed earlier, is the last two groin compartments had never really completely filled. So the ends of those groins were exposed. You're right. We don't know what's going to happen. If you start removing those, what happens within the groin field? And they're going to have to watch that very carefully because you might see that they'll lose some of the beach. They had such a wide beach there and they had so much sand in the dune system, they could afford to lose a little bit. If they start losing too much, that's going to be a real problem because they're going to have to figure out some way to rectify that. And that's part of the uncertainty of this type of situation.

They've tried modeling, but, as I said, the data that they have for the south shore of Long Island are very sketchy and modeling has its limitations, as anyone will tell you, especially when you get in a complicated situation like this. You have to be very careful about using the results of the models.

MR. O'CONNELL: Jim O'Connell, CZM.

Just to jump to the future. What is the State of New York doing as far as a proposal to rebuild the structures while the interim -- while the long-term plan is being formulated? Obviously, you don't know what the end result will be, but what are you doing as far as the

redevelopment process in that area while the interim -- while the long-term study is being completed?

MR. TANSKI: What happened is those 250 houses that were downdrift of the groin field, the owners got together and they incorporated as a village, which in New York means you have certain powers as a recognized government entity in New York. And they started negotiating. That's how essentially they won the lawsuit. They became the Village of Westhampton Dunes, and started pushing this.

They worked with the State Department of Environmental Conservation and the Corps of Engineers and the plan -- the 30-year plan, this interim plan that the Corps developed, they built a dune there and some of the people gave up their property rights. They gave an easement for that dune and the group, the community got together and they moved those houses 25 feet landward of the landward toe of the dune, which is what the Coastal Erosion Hazard Act says you have to do. So they moved the development back somewhat, and met the state regulations.

Westhampton is kind of unusual in that they got exempted from the federal flood insurance regulations under the Upton Jones Amendment. It was actually written into the legislation at the federal level that this does not apply to the Westhampton area.

So essentially they're meeting the requirements of the Coastal Erosion Hazards Area Act because they have a 30-year commitment from the Corps. That project is $80 million—$50 million initial construction and $30 million to maintain it for about 30 years.

MR. O'CONNELL: That's federal money?

MR. TANSKI: It's federal, state, and local. I believe it's over the old cost sharing agreement, which is 70 percent federal, 30 percent state and local interests.

DR. GIESE: Any other comments or questions?

MR. REYNOLDS: Yes. My name is Mike Reynolds from the National Seashore here on the Cape.

And I was just reading something the other night from Steven Leatherman who called this basically a coastal subsidy much like in the western United States subsidies for timber harvesting, and that kind of thing. Did that come up at all in terms of conversations or the politics of --

MR. TANSKI: A coastal subsidy? Well, you could also say they were about to lose $250 million. In one way you'd look at it, the homeowners could have gotten the $250 million and probably worked to get something else done there because even if they walked away with the $250 million and nothing was done, you still had the threat of breaches there.

So this is an unusual situation. This isn't like Fire Island, where it's very debatable whether it is natural erosion or erosion due to human influence. They couldn't find an expert that would get up and say, yes, this is just natural erosion. So I'm not sure that you can use this as a case study for the natural shoreline and people developing there. This is something that's a little bit different.

MS. SFERRA: Kathy Sferra, Cape Cod Commission.

Just to follow up on Jim's question, I guess, is the presumption then that those 170 houses that were lost will eventually be rebuilt or has the state or other folks made any efforts to acquire some of that land?

MR. TANSKI: To my knowledge, efforts were not made to acquire the land. Once again, it's a decision that's made politically, and I think the homeowners were not willing to give up that land. They felt they had been wronged, and they were willing to fight. That's why they stayed in court. That court battle took about 20 years. And, they were not going to give up on that. And they knew they were going to win. That was going to be at least $250 million. The state would have to acquire it for $250 million, and they weren't about to put in that amount of money. There's no federal mechanism to put in that much money.

That's one of the problems, once again, if you're dealing in a highly urbanized area, that shoreline property is very, very expensive. I mean, you're talking, in some cases, about million dollar lots. Acquisition is not so easy to do. We have trouble even buying farm land in Suffolk County because of the land prices there. So they looked at this as a cheaper way to resolve the problem.

Once again, if you acquired the property, you still have the issues involved with what's going to happen in the bay and the mainland area. So just by acquiring that property, that's not the whole problem, and that's something that has to be considered, and that's what they were looking at.

The other thing is, of course, the state and locals knew, well, if we do it this way, we get the federal government to help pay for some of it.

MR. PESSOLANO: Mike Pessolano again. What about the concept of purchasing incrementally the properties, the most vulnerable ones first, and avoiding, forever, the replacement costs and all that goes with it. You know, allocate $5 million a year, until you get to the point where you've wrestled the problem to the ground.

MR. TANSKI: Well, acquisition has been looked at, but once again, I don't think they feel it's very viable there when you have development interests that are willing to pay that much. And the other problem that they're dealing with here is -- This is not like a mainland situation. So you don't have a buildable lot, but what are you going to do with that area anyway? I mean, you have the groin and you know it's going to keep eroding if you don't do anything. What is the decision we're going to make? Are we going to allow that new inlet to form and the changes to occur? And that's what we're dealing with right now; how far are you going to go before you say, okay, well, we can't afford to keep a barrier island, the integrity of the barrier island there, and we're going to have to deal with these issues on the mainland area. And that's one of the issues that was being discussed.

So even if you bought some of those properties, you'd still be faced with having to do something, similar if you wanted to stop the inlets. It's not just the property owner on the

barrier island that you're considering; you have an urbanized coast behind the barrier, too. And that's one of the sticking points.

MR. PESSOLANO: But it seems to me that, just to take it to the next step, 30 years from now the next generation is going to be having to deal with the exact same lawsuit in the exact same location, and the stakes are even higher.

MR. TANSKI: Right. Well --

MR. PESSOLANO: So whose interests are being served by --

MR. TANSKI: Like I said, the Corps is supposed to come up with another plan that's supposed to be the 50-year plan. They won't have it ready until 2002. But that's one of the things that they are looking at is how long is it viable to provide protection. They do their economic analysis, and I'm not going to defend their economic analysis by any means. But that's what they are supposed to look at is, what are you going to do for the south shore, what are the costs going to be, and what are the benefits going to be. They have to look at that.

It's not just the open ocean coast when you have a barrier island system. It's what's behind that. And that's what becomes an issue. In some cases, you can have a new inlet form and it's probably not going to cause severe adverse impacts. If you move that inlet over into Great South Bay, which is much bigger, a new inlet might not cause the same problems. But the problem is we don't know and politicians don't like it when you don't know and you have the potential of affecting very large groups adversely. And that's one of the problems; we don't quite have enough information to quantitatively say, well, we know this is going to happen. So they wait until their hand is forced and that's the type of solution you come up with.

DR. GIESE: Okay. Thank you very much. We're going to take a 10 minute break.

(Break)

DR. GIESE: This is our last session this morning. We will begin the last of the topics. This one is entitled Monitoring Changes in Sustainability. Quite a different model than the situation that we've just heard. To introduce this, Mike Reynolds, of the Cape Cod National Seashore -- Mike, I don't know your title at the Cape Cod National Seashore.

MR. REYNOLDS: It's resource management.

DR. GIESE: -- resource management at the Cape Cod National Seashore. We'll begin discussion with the management practices at the seashore. Mike.

Monitoring Changes in Sustainability

Mike Reynolds, Cape Cod National Seashore
Graham Giese, WHOI Sea Grant

MR. REYNOLDS: Thanks, Graham.

This next segment is going to be a little bit of a difference and a little bit of a change from our last conversation of Fire Island, so I want you to try and sit back and certainly take this all in as comparison. I do want to pull in some of what I was observing in this last section that Mr. Tanski brought down as far as our conversation later.

I'm going to show you now some examples from a system that's a little bit different and that we're extremely fortunate with the Cape Cod National Seashore and on this section of Cape Cod in that we're going to argue -- Graham and I are going to argue -- that we pretty much still have a sustainable natural system, with a few minor exceptions here and there, that's operating. And my take-home message is today that basically good science and good monitoring and good information can often lead to a lot better decision-making. And I'll show you some examples of what we're trying to do. I'm also going to try and breeze through quickly some of our policy and management and legislative mandates so that you at least have a grounding as we stand here and talk to you about where we're coming from as a National Park Service unit. It's going to be very different, and I'm not naive to the fact that as Conservation Commission folks and local folks you have very different environments to work with. So I'm not sitting here advocating today, "let nature take its course completely" in all situations. In fact, if you interact and know us at the Seashore, you know that that isn't exactly the case. Think of these things as the high bars of where we are, and I will point out where these policies are very much fitting with evidence coming from science as we monitor things.

We often have a weather channel syndrome, where the public must buy off on the concept of the "killer storm" and the horrific erosion. The irony of our situation in managing the seashore and managing other places that you folks are involved in, is we need erosion, we need these horrific killer storms. It is the sediment and it is these source materials that are also feeding our beaches. The problem is when we talk about sustainability, the thought that I'd like you to frame as we talk about this today is my definition of sustainable management of coastal systems does not mean fixed in time. We're going to use Nauset Marsh in Henry Lind's backyard as sort of an example of what sustainability means.

Just to frame it for two minutes, here. Every single park in your national park system units -- and I would assume it's very similar in the town governments -- have a legislative authority, and I have learned over time that when I paraphrase things, people say, you're lying, so I just copy it right out now. But I just want you to focus on this part here. In order to preserve the seashore, it basically says no development or plan for the convenience of visitors shall be undertaken which would be incompatible with the preservation of unique flora and fauna or

with -- and this is the key element for today -- with the physiographic conditions now prevailing.

Now, that language in itself has caused us many problems, which was, are you supposed to manage this thing exactly frozen in 1961? And our answer is basically no, it's managing natural systems as they were meant to be preserved from the development pressures and changes from when the park came into being.

There's always a series of management policies, probably guidelines like you have in your plans. I'm pointing right to here. Natural shoreline processes will be allowed to continue, except where control measures are required by law. These sections here go on to talk about everything from adjacent land use practices that one landowner might have private rights but are severely affecting the natural system. Fire Island is a good example of how one neighbor upstream is affecting the neighbor downstream. It goes into specifically prescribing to us about certain actions and how to deal with them such as dredging and what we're going to do. The bottom line that this boils down to is we are trying to trust the natural system and natural processes, when allowed, to kind of take their course, that often-times the natural shoreline processes of erosion and sedimentation will solve your problems for you, certainly, more sustainable over time than human developments needing maintenance such as beach nourishment or riprap structures.

When you roll up your sleeves at my level in the field, you take a lot of this stuff and you have to boil it down to a management plan. There's about 10 or 12 of these in our new management plan. But our major goal, boiling all those policies down, is to allow these natural shoreline places to take place unimpeded while also counteracting human caused disturbances. What the heck does that mean?

Basically, it means trying to look, even where we have non-natural system processes working anymore, and search out the components through science and through monitoring and through some objective observation of what pieces of the natural system may be able to be brought back into play.

And this may seem a little naive, and you're probably thinking of an example, such as I've got 25 miles of armored shoreline now. I have to deal with things in an engineering solutions kind of sense. I may or may not disagree on that, but there may be elements that you can preserve without jumping to developing a shoreline for protection. There may be pieces, there may be an ability as engineers, for example, to harness what you traditionally do in coastal armoring and relook at the whole picture. And that's what we're trying to argue, I guess, today, for you to take a look at.

Are most of you from Cape Cod? Are there folks from off Cape Cod here at all? A few? Well, I'll just quickly let you know. Right now you're looking at a series of shots -- you can see the dates -- of an area called Nauset Marsh. It's one of our largest marsh systems in the Town of Eastham, the Town of Orleans, and a chunk of Seashore land. It's very complex. It's a beautiful

marsh system. As you head down Cape and sit at Fort Hill and look it over and you can kind of get a feel for it. Classic barrier system and inlet changes.

In 1971, we started looking back. We have data from 1868, 1977, and then some inlet data from 1971 to '86. What I want to show you just real quickly is how through monitoring we've been watching this inlet change. This is something you can come up and take a look at the break or during your breakout sessions. There's three shoreline configurations on this map, and this is a similar area to here. This is brand new as of a week ago off of a GIS system, so I didn't even have a chance to translate it to a slide. But this beach system that you're seeing is 1994, and on this map is an 1868 shoreline which is, if you watch my hand, it's sitting out about here. It's a solid run of barrier beach, except there was the inlet to Nauset Marsh right down here at the bottom. For those of you familiar, this is the Nauset Heights area. Right now if you walk to the beach, you'd never know that an inlet had been there, but you can tell from this perspective, look at this little channel, you'll see that it was filling nicely.

One of the questions that you think about when you're doing this monitoring is, what if in 1868 we had the resources and we decided, for whatever political or private reasons, we're going to freeze this inlet right here. We don't want this inlet to change. It would be more sustainable from our perspective, in 1868, to hold this inlet in place. And we ask ourselves these questions because we like to predict sometimes, what would be happening to Nauset Marsh, what would be the system right now and, indeed, through this monitoring the system doesn't want to do that for whatever reason. Graham's going to illuminate more.

But this is what I'm talking about. That was the 1868 inlet. Here's 1971. Here's '86. Isn't this exciting? It's all in our lifetime.

Here it is again in 1990. And here it is some three years later. And look at this. We have two of them. The general progression is this inlet is migrating north. We have two of these now, and, indeed, a year later you can still see it on our ortho-photo.

And then something happens, the storm of '95 or so. We lost 16 feet in one winter right in front of Nauset Light, give or take during this period.

And lo and behold, the following spring, most of this inlet now is filled up, so that our inlet configuration currently is just about here, if not just a little south. Is that right, Graham?

DR. GIESE: There was actually a poster last night showing that system.

MR. REYNOLDS: So, understanding the system and watching this change and kind of running through your mind as decision-makers and managers, what would be happening to us if we tried to freeze the system and the consequences for the future of a system unable to sustain itself without human intervention? I took some data from a recent report, and I'm just using these to reiterate and also to let you know that these are available to you. We have partnerships with USGS and Woods Hole that produced these.

This is another very recent one that I just got a copy of this week. It's a flushing study, and all of these characteristics that may or may not seem to directly relate to beach and sand

and this kind of thing, this flushing study shows what circulation's happening in and around the marsh system. But they all end up interrelating because we're understanding -- One of the questions is should we be trying to mitigate, based on that policy, is human influence the cause or is it natural process? And if it isn't human influence, to what degree do we take a stand on it?

And I'd like to just put in a plug. I apologize if you've already talked about this. I know Jim O'Connell is here. But this is certainly a Bible for us as well, and if you are in the state or on the Cape we find, beyond science, which you may or may not always have at your fingertips, this is a great tool (Barrier Beach Guidelines[1]).

I've got just a few more minutes. I want to run through a few slides. And these slides are going to sort of lay the groundwork for Graham to come up and talk about some of these systems.

These are some of the examples that we're talking about. Here we are on Cape Cod. This is the Nauset Marsh system that I was talking about. This is also the North Beach system, which is a highly controversial section here because we have a lot of private landowners in town and, as you know, even -- It's not on this image. -- we've had a large break.

This section right here is this image here. If you could see my shoreline, this is the shoreline just a few short years ago that stretched all the way across there, and now we have this large opening, this thing here. And the question that I ask you, is this a sustainable natural process? We'll talk about that.

Barrier system in the inlet. Here's Coast Guard Beach. The Park Service was not immune to bad practices. One of the largest parking lots you'd ever want was just here just about less than a decade ago,

UNIDENTIFIED VOICE: A little east of there, Michael.

MR. REYNOLDS: It's gone now. Here's that Nauset Inlet. That other inlet that I was showing you made this an island, and it was right up here. It's moving forth -- back and forth at this point. Great shot of a barrier island with a lot of disturbance.

This is the North Beach area. Certainly an example that we all have where we have a lot of discontinuous land use practices, and we're all going to have to come together on it. The Seashore owns in this area patchwork in between private lands, so necessarily our policies versus the private landowner aren't going to necessarily jibe over time.

This was three winters ago. This is Highland Light up at the top. And the reason to show you this is this was a massive land slide. It took out 55 feet in one night. This is our jeep, to give you a scale, right here. And we couldn't drive around it on the beach. We were monitoring plovers at the time. Probably have some underneath there. We never could figure it out.

---

[1] Guidelines for Barrier Beach Management in Massachusetts: A Report of the Massachusetts Barrier Beach Taskforce. 1994. Available by contacting Massachusetts Coastal Zone Management at (617) 727-9530 or mczm@state.ma.us.

This is mostly, obviously, a clay material, and this Highland bank -- And we got phone calls from folks saying, this is catastrophic. But indeed, what we're doing with this is we monitor it; we're able, through feldspar monitoring and all kinds of sediment analysis, to figure where this material goes once back in the sand transport system.

This is Long Point, down at the end of the Cape. Just look at the growth that's happening here. So where it taketh away, it kind of moves up and goes forth, and it does take a little bit of monitoring, a little bit of foresight of the whole system, and of various time scales to really understand what's going on out there.

We're not immune to human disturbance at all. Look at those dunes. That's Pilgrim Lake, right up there. This is the Bay side. Highway 6. Look at these dunes kind of instantly stopping up there. There are a lot of things that we need to do.

What do you suppose these odd tracks here are? That's beach grass. That's dune grass. So, in the process, we're trying to find -- In this case, management decisions were made in the '70s through monitoring, that the best sustainable practice would be -- well, certainly there's a little bit of benign caterpillar work that still goes on here -- look at the system and try to place back what might have been vegetation succession in this case. Beach grass is an early successional species, right? It's the first thing that kicks off and it's meant to lead into things. But we've continued to monitor it, and one of the things that's come up in the last two summers is there's a huge swath of this that's completely dead now. We don't quite know why, except we theorize at this point, as this is early successional species, it's just doing its thing and dying off, and unfortunately, nothing else has been following back. So this game continues on.

Beach Point. Do you think it's comfortable to go stand in front of the Truro Commission and say, just let nature take its course here, okay. This is another Fire Island kind of thing. So it's not set in stone, but one of the reasons I wanted to show you this is this is actually called East Harbor to many folks, many ecologists and historians. This was a working harbor with an inlet down here, and apparently you could sail right in and out of there. It's now a dying brackish lake, with mostly fresh water trying to get in. And motel owners are swarmed by mosquitoes and midges that are showing up and breeding in this habitat.

In this case, we would never advocate, as the National Park Service, that we condemn landowners and reopen this and hopefully it flushes out. Instead, we're going to try and work with engineers to figure out with existing underground pipes that do try and flush this thing, why it's not flushing as well. So it's aiming for sustainability through bits and pieces of mitigation, if we have to work around things rather than work against it.

But ultimately, if you can, in your systems, try and step back once in a while and look and see if you do still have chunks of natural processes working and how they might be able to be enhanced.

And that's it, I guess. I'll give it over to Graham.

DR. GIESE: Thank you, Mike, very much. We all come with our special points of view. I am a geologist and my first slide will show a page from the *Citizen's Guide to Geological Hazards* prepared by the American Institute of Professional Geologists.

The chapter on coastal hazards points out that economic losses can be decreased by developing only on favorable geological materials and by managing coastal development in accord with natural shoreline processes. This is the same kind of thinking as that incorporated in the legislation that Mike read us when it speaks of allowing natural physiographic processes to continue unimpeded in the Cape Cod National Seashore.

But, of course, we often don't allow that to happen. I'm going to show again, with Jim O'Connell's permission, a figure that he started us out with yesterday morning, with some small alterations. We've removed the seawall that goes around the inner shore, and we've added a little bit of vegetation on the bank that's protected from wave action on the inside. We're going to end close to where we began and think about the cost of making changes in the coastal landform system.

We can think of the unaltered system as being self-sustaining. It works all by itself. It doesn't need anybody to help it. We have a barrier beach, dunes and marshes nourished by sediment supplied by eroding banks. The system works, and it really doesn't cost anything.

But, of course, the reality is that we often DO have to manage it. For example, we need navigatable entrances to our harbors, so we must dredge channels through tidal inlets. We must prevent immediate shoaling of dredged channels by constructing jetties across the beaches at either side of the inlet.

It seems to me that one way to improve management of our shore is to keep track of the long-term costs of our activities. We make exceptions to do this and to do that, but as someone pointed out just before the break, after a while, this gets to be extremely expensive. What happens 30 years later, I think we were asked. What happens 50 years later?

Well, we really don't know how much we're adding to our burden, and the reason we don't know is because we don't keep track of what we are doing, of small changes in one town, small changes in another, small changes in a federal facility or a state facility.

It may be that if we were to use Sandy's measure of one as being a full value, we could say that the sustainability of outer Cape Cod is, well not one, but maybe .95 or .9. Maybe the sustainability of the inner shore of Cape Cod -- the Cape Cod Bay Shore -- would be .7 or .8. Does everybody follow that sort of quantitative measure that was introduced yesterday?

Perhaps we could perform a similar quantification of the sustainability of segments of our coastal landform system as a baseline for determining how we are changing it. But we don't have to. We should be able to tell how we're changing the sustainability simply by evaluating the likely effects on the system of the projects that we've allowed.

Activities that affect coastal landform systems must be approved by our conservation commissions, following the regulations that Jim has told us about, and others that the towns

have in the form of by-laws. Perhaps, then, we could review each of these projects as they are approved, and at the end of, let's say, a year, look at them to see how we changed the sustainability of the coastal landform systems in the town. If we could do that in all Cape Cod towns, we could see how we changed the sustainability of the coastal landform systems of Cape Cod. And, perhaps, seeing what parts of our towns or what parts of Cape Cod lost sustainability and gained sustainability, we might be able to accentuate the positive, and maybe not eliminate, but at least reduce the negative.

Let me give an example of an activity having a positive effect on sustainability of a coastal landform system. This case that came up before the Conservation Commission in Truro. It concerns a house on Ballston Beach, a narrow barrier beach separating Pamet River and the ocean. No, probably the house shouldn't have been built on a barrier beach, but it was - a long time ago. As time passed, the dune migrated landward and the house, being in the way, inhibited further movement. The owners wanted to make a change. They went to the Conservation Commission and asked to raise the house above the dune. Well, of course, it was approved, and it had a positive effect. One could quantify that effect if one had a checklist for activities in dunes that could impact the sustainability of a coastal landform system.

Other example of activities with positive impacts could be opening a dike to allow increased flow of salt water to a salt marsh, or closing a road across a barrier beach to permit it to grow vertically. On the other hand, building a seawall on an eroding bank that is an active source of beach sand, or building a home on a barrier beach - these activities would be likely to have negative effects.

We have made a separate checklists for coastal banks, beaches, dunes, barrier beaches, tidal flats, salt marshes, and land subject to coastal storm flowage. This exercise is akin to the program that Sandy ran us through yesterday. Each group will work with Notices of Intent and Orders of Condition for five different projects that were supplied by Jim Mahala. So let's work with those using the checklists. I'm really curious, as Sandy was, to see how this works, to see whether you like the general idea. And if you don't, I'd really like your comments.

Nauset Inlet and beach. *Photo provided by Mike Reynolds, CCNS*

Reports from Breakout Group Facilitators

DR. GIESE: The last roundup. I really appreciate all of you staying, everyone who's here today. I think it's very important to have this view and input. And I certainly would also like to have an overview or discussion at the end where at least we can put together our conclusions.

So let me then just turn to our worthy panel and start with Julie.

MS. EARLY: Well, our group enjoyed reviewing the various case studies, and actually were in good agreement with Graham's determinations. If we were to examine the five projects as if they were in one town, there would be a neutral to slightly positive impact on the sustainability of the town's coastal landforms. There were two projects with a slightly positive effect, two considered to be negative and one basically no effect, or if we use Graham's judgment, a "minor positive."

The group found that the process and checklist are useful, but they found it difficult to analyze some of the effects that the projects would have. The group found that the process was somewhat subjective, which perhaps could be further refined. There were gray areas depending on how you interpret the particular project and its impacts.

If the checklist were to be used by towns, some quality controls or training should be used to increase the accuracy and consistency of the results. The checklist could be used for conservation commissions to maintain records on their decisions and provide a historical view of the impact of these decisions on coastal landforms. The checklist also has potential for being used on a regional basis to record the status of coastal landforms beyond one town's limits. A GIS system might be appropriate for tracking some of this information.

The group felt that the checklist is a good tool for policymaking and a method for tracking and analyzing cumulative impacts, and the impacts of regulations on the sustainability of coastal landforms. Some questioned whether this method would reduce the need for site visits, but it was a debated point.

MR. HENSON: I don't believe that I did a great job at reiterating the purpose of this exercise, and that it is to be used as a tool for the evaluation of success that maintains sustainability. Instead, we mistakenly got headed down the decision-making tool road in at least a couple of our small working groups. I should have clarified the purpose more specifically up front.

Once we got focused properly, I think the exercise went fairly well. But similar to the green team there were a couple of things that came out. First of all, I think we determined that consistency of review is very important.

There were a lot of similarities between our analysis and that provided, but we also identified some different interpretations. Clearly, interpretation, we feel, needs to be consistent throughout. So, I'm not sure that we would be able to fairly use results arrived at by one conservation commission as compared to another if this analysis was done internally.

We decided that in some of these cases there was more information needed -- I know that's a familiar tune to conservation commissioners. Also, the terminology was a little bit confusing, but we ultimately decided that probably wouldn't be a significant issue, again, if the reviewer were familiar with that terminology and the definition of those terms.

It was suggested that in the out years, three to five years after the project had been constructed, it would be a worthwhile exercise to do some ground truthing trips and to see just how this analysis had panned out.

And finally, it was suggested -- and it's something that Coastal Zone Management's Cape and Islands office is in the early stages of implementing -- that a peer review of these Orders of Conditions might be beneficial in terms of more positive results at the end of the exercise.

DR. LEAVITT: Rather than address the rating process, I would prefer to talk about the discussion that ensued after we went through the process. This is going to be a flow of consciousness-type of report because we went off on many different tangents. I asked a question, the same as I did with Sandy's ranking system, whether this was an appropriate way of evaluating how towns are doing in land for conservation. There was a real mixed bag of responses. One of the primary concerns voiced was that you can't really take all of these cases and equally apply them to rating how a conservation commission is doing or how a town is doing. A town's level of success and failure, with respect to landform sustainability, is very much dependent on the individual situations and some may have much more significant impacts than others. That isn't really accounted for in the current rating process.

Some of the important points that came up specifically was the fact that all projects are not equal and they must weigh projects according to their relative impacts within the town. Also you need to think in terms of cumulative impacts, where the group was thinking more of cumulative impacts evaluations within each individual project.

The coding system was confusing. My group recommended that you set up some kind of continuous scale and use less confusing terminology; for example increased sustainability, neutral or decreased sustainability; something that directly applies to what you're trying to get at.

From there, we started talking about how does one compare impacts. And again, they reiterated that it was tough to translate from a group of individual projects and jump up to a town rating.

This next statement came as a complete shock to me but the group speculated that it was potentially a dangerous system because it might be used as a political vehicle. I never thought that would ever happen, but it might be used politically, both within towns and between towns. So you have to be very careful. And, again, it is the same thing that we talked about with Sandy's proposed rating system, that it really should be used as a guide and not as an ends type of comparison. If you are going to use this type of a system, you want to use it to

allow people to judge how they're doing but not use it as a judgment tool. All in all, the group thought this was a very good exercise. One person said it was better than the number matrix because it really required you to think about how projects were having an impact on the total system.

Some specific changes the group would like to see. You have to refine the questions because people found that some of them are confusing and different people interpreted them differently. This is based on the fact that we had five different groups evaluating these and the question kept coming back to 'who's going to be doing this?' Is it one person that's going to be going to all of the towns doing it? Is it going to be three people and they do it as a team? You know, the way the questions and evaluations are set up, it is very subjective and you have to be very careful about who is doing the reviewing.

It didn't address economic benefits. It only addressed economic costs. So the thought that a project may be economically beneficial to the town was not addressed.

It was hard to group all of the projects together because of the relative impact and the conditions may vary. A better idea might be to break down your evaluation by resource area so you rate each town as to how they are dealing with each of their resource areas, e.g., barrier beaches or marshes, and not lump them all together. You can then come up with a cumulative impact assessment on salt marshes, or a cumulative impact assessment on barrier beaches, etc.

The survey needs to be time efficient and user friendly because people just don't have much time for filling out these kinds of forms. That comment led to a mention of the development of some kind of computer program that would allow you to enter the data in and have it automatically compiled.

Another comment the group came up with was that it was difficult to look at paper and assign impacts to it. People kept saying they couldn't really judge it because they didn't see the plans and in our case everyone was used to looking at the plans. They can't just take the words of a Notice of Intent. They wanted to see some drawings. Even with the drawings, you've got to really understand what the effects are. There's that question again, do we really know what the effects are going to be based on a Notice of Intent or an Order of Condition.

From there the discussion branched into whether modeling and/or monitoring may be activities that you would want, in conjunction with this assessment program to check it and to make sure that it is giving you the results that you want.

Finally, the last comment is that one thing that could be done as a basis for comparison is to develop an annual aerial estimate of impacted areas. The ultimate goal being that you want to minimize your impacted areas in your town so with annual aerial records you can compare impacts/development from year to year. With the advent of GIS mapping, this probably wouldn't be that tough to do at this point in time.

I think my group was great, except they made me work way too hard.

DR. PEDERSON: Six out of 10 of our members were Conservation Commissioners, and our working group response is different than the previous group(s). We compiled all of the results in a matrix to assist us rank our decisions and outcomes relative to the various natural landform systems.

As requested, we looked at these decisions made by the conservation commission or Department of Environmental Protection and that decisions were made within the regulations.

Overall, the group's evaluation was very consistent with Graham's assessment. One of the differences was attributed to factual knowledge of a specific project. In this case, there was supposed to be some beach nourishment that doesn't occur, so we gave it an A and Graham gave it a positive. There were some areas that were a little gray in terms of interpretation and certainly the rankings differed with Graham's values..

Rankings of the towns relative to the list ranged from A to F. Towns, as a whole, were given a C- for coastal banks; with coastal dunes, we gave it a D or an F; with coastal beaches, another C-; with barrier beaches, it ranked a D; with salt marshes, it got a B+; and with the land subject to coastal storm flowage, B/A largely because nothing seemed to impact it.

What were some of the problems? The problems really appeared to be not so much with the decisions made by the groups -- by the conservation commission, but the fact that the regulations don't really encourage, sustaining the natural landforms per se. The group added a caveat. For example, if we go back 20 years -- and this is the group speaking -- that the regulations have changed, and have improved coastal zone management. If one applied the same process 20 years ago, there may be many more negatives and more negatives with very significant impacts. If approached in five-year segments, as the regulations changed, then the decisions and the improvement can be viewed in that context.

Our group liked this very much, this process and this checklist. Yes, there are some areas that could be cleaned up in terms of the interpretation and so forth. But on the whole, it seems to work. It seems to be fairly straightforward and simple and can potentially indicate how well these landforms are being sustained in the long term.

One of the other issues that we might point out is we're talking about managing altered landforms, so it's not easy to go back and know what to do because I don't think there's a lot of territory -- this is not a well-charted territory. There isn't a lot of field data, and not a lot of data actually on the project or on the historical perspective. So, this is basically a very good approach and the group likes the checklist.

DR. GIESE: Thanks, everybody. I would like to say a word before we open it up, and perhaps Mike would, too. Do you have any comments you'd like to make at this point?

MR. REYNOLDS: The only thing that I could add is that we are struggling at our level, which is sort of a non-regulatory level, really more of a land management level, with concepts of sustainability. It's an easy concept that you think you understand, and then you sort of get into it. And what we're struggling with now is coming up with what they're calling in sustainability

communities "standards and indicators for measurement." It takes a lot of thinking in order to do that. It also could be a never-ending cycle. So we're trying to figure out where to fish or cut bait on a standard indicator, so let's all share on that one because there's no easy answer.

DR. GIESE: Certainly, there are no easy answers. The work is not only hard, but, as I said when we started, it's getting harder all the time. I would like to clear up one or two points. One is, at least in terms of my intention in developing this checklist, it certainly was not my intent to develop a means to rate any town or rate any area, especially not to rate a conservation commission. The purpose of this is to increase our knowledge, our understanding of what is happening. There are lots of reasons that one might approve a project which does not increase sustainability of coastal landform systems.

I'm not thinking of this as part of a regulatory process, that you look at these checklists when you're deciding what to do. I don't think you should at all. This is rather a way of understanding what, in fact, we have done, after, say, a year. It's only through knowing what we have done that we can plan for the future. We may like very well what's going on, but at least we ought to know what it is. Right now, we don't know. We don't know how we're changing the sustainability of the coastal landform systems of Cape Cod.

What I think I've learned already from the little bit that we've done is very interesting. It suggests that we're changing in positive ways in some respects, more in some geographical areas than in others. Often, I'm beginning to believe, the negative effects are in specific locales. These may be in some cases areas that we want to keep going that way. But even so, we need this information for our planning purposes.

Anyhow, I'm very appreciative of what you have done. It has provided a lot of information. What we'd like to do is go forward with a couple of test communities. I say "we" because Julie Early of the Cape Cod Commission has agreed to work with Sea Grant on a pilot program, and I think we'll get some guidance from Mike and the Seashore. Some of you have spoken to me about being part of the pilot group, and I'd like to hear from anyone else who would like to participate.

But now, do we have questions, comments, in addition to those from the panel? Yes...

Wrap-up Debate and Discussion

MR. LYNCH: I have one comment -- well, a couple of comments that I came out of this with.

First and last of all, I think the first thing that came out of this was that I have an appreciation of the other -- I guess the word is ancillary professions that I'm working with, because we generally are in engineering. And the one comment I'd like to make in trying to get our -- what we're up against when we go on a job is that clients don't hire us to prove that these things can't be done. So, I mean, it's hard for a man -- a man hires you, gives you a retainer or something like that, you start spending time on it, and then he really doesn't want you to come back and advise him not to do this.

A real quick one that happened to me was in Nahant. A man bought a house and it was added on to. It didn't have any Order of Conditions or anything else, and it was going over the cliff. And, you know, if you did it purely, he should have let it go. It was pretty hard to tell him that, though, since his wife was leaving him and his house was $300,000. I mean, we had to prove to the Conservation Commission that we could save his house. That's our problem. We're sort of like lawyers. We're bringing up a case for our client. And sometimes, we don't mean to be on opposite sides of the fence, but...

The second point I was going to make was I thought what I just heard you say was a very, very good remark, what's going on here, that maybe that the whole -- if you wanted to sum this whole thing up, how do you approach a project? Is it for a while you make no decisions and just say, you know, just that question, what's going on here. Is it an economic one, is it a social one.

One thing we didn't bring up at all today was endangered species. You know, plants and animals and things like -- No. Plants, we did. But animals, birds. That could enter into it. And what else was I going to say?

I'm not entirely against using a matrix. I'm not entirely for or against anything coming out of here. I hope I just come out of here thinking, that you've made us all think. Maybe put ourselves in the position of somebody else. As an engineer, I start thinking -- I start seeing how a biologist thinks, how a cultural geologist thinks, how conservation thinks. But in this idea of dot matrix, I think what I've come out of it is I'm not so much in favor of the dot matrix that has numbers in it, but I'd like to see a dot matrix with something like movie ratings, where, you know, there's black dots and white dots, and the blacks are bad, the whites are good; and if you look at jobs and you see a whole bunch of black dots, meaning the whole screen is splattered with black dots, you know, it's probably an indicator that you better be real careful how you handle it. And yet, other jobs are in -- And I come from Marblehead. Other ones, the Conservation Commission will say to us, you know, this really -- site visits are very important. So I shy away from that, the remark that you want to cut down on site visits because site visits

tell you before you make any decisions -- and Marblehead does this -- they almost insist that we have a site visit. And it may be just for five or 10 minutes. There's nothing going on here. And I like that expression, I really do. It kind of boils things down. Kicking the tires as to what's going on here, or however you want to call it. I think that's a real good way to start these things, and don't jump right into them.

And lastly, I guess I want to say, and I'm sure the other people feel this way, I want to thank you because I really did get a good appreciation of what other people, other professions and other professionals, whether it's social, economic or anything else that's going on. You started me thinking.

Thank you very much.

DR. GIESE: Thank you very much for your comments. I think that everyone should be commended for the give and take that we had.

Your comments, too, I think, have kind of moved us into the wrap-up phase so that I think we should have comments now about the whole purpose of the workshop, and not so much any flattering ones, but rather -- I mean, thanks for those -- what I mean is any major points that might want to be made as a result of this. I actually had some myself. So I think I'll just mention those.

Starting with Jim's talk of yesterday morning, it's clear that the 1978 provision, that is to say that buildings existing prior to 1978 can, under certain conditions, have protection if they're on a coastal bank, and Jim told us how that came about and how it wasn't the idea of that those who were the advisors originally of the regulations but that there were political reasons, economic reasons. I don't want to put words in your mouth. I can't remember -- Anyhow, you said it very well, Jim, and it's on the record.

But that is there, and I think that we do have to think about that for the future. I mean, how long will that last? Will that last for 100 years? Will we still be protecting houses 100 years from now that were there prior to 1978 or -- all the other questions that others raised. I won't pretend to have a grasp on all of the wonderful comments that were made about that, but it certainly seems to me that that's focused as a major question.

And another one that really relates to that was yesterday afternoon with inner shores. Again, that same question came up, several of the panels' breakout groups had suggested that perhaps using what is presently used for exposed shores be used in inner shores as a reason for not allowing protection. That's certainly a comment that seemed to me to lead into some hope of -- might be a means of getting out of the difficulty that we are in inner shores, or one way to help with that.

So those are two comments that I have. Do others have any? I sort of condensed that from the whole two days.

MR. WATSON: I just have an overall comment. I think that we spent a lot of time talking about what's appropriate -- where is it appropriate to attempt to reverse, you know,

mechanisms for sustainability and so forth, but for some of us who don't have strong engineering backgrounds, there was very little on the mechanics, how to do these things -- may be bad ideas, you know seawall versus riprap versus groin versus jetty versus -- what was it, bag of sand? It was a...?

UNIDENTIFIED VOICES: Geo-tube.

MR. WATSON: Short retention. I think that Jim made a passing reference to some individual system that was used on the South Shore that had failed in its original application. It was so flashing; I never quite got a sense of what it was. And somebody has some literature here about a system for trapping sand in suspension. It was a member of the audience who had some material from an engineer. And I really think, even now, if we could maybe spend 10 minutes on -- after the fact even, on some of the hardware, because I think we're all largely with a conservation background. We're sympathetic to the idea of minimal intrusion, trying to go with what's happening. On the other hand, as we all acknowledged, there are times when we really want to do something and we don't really get a sense of what tools are the least intrusive. I've always assumed that riprap is nicer than walls because it's broken up and it's got a lot of texture and it looks nice. And as far as energy, I don't know, maybe the function is the same as the wall in terms of transport.

So, I sort of wish we could have a little time on the basis of an engineering sense.

DR. GIESE: Thank you for that comment. I understand it very well. I very much sympathize and would like to help. What I suggest we do is that we continue getting other comments from people, and then anyone who could contribute to a short discussion, stay after the major -- after we end the major discussion, if that would be okay. I'll try to, and anyone else that could stay for a few minutes and discuss the hardware, the characteristics --

MR. LYNCH: State of the art.

DR. GIESE: State of the art. I am not, myself, on top of it, so I hope others will join us.

MR. WATSON: Jim refuses to know anything about these things.

MR. O'CONNELL: I'm a biologist.

DR. GIESE: Jim, please.

MR. O'CONNELL: Jim O'Connell, CZM. I just want to follow up on this request. Giving you 10 minutes, giving you 20 minutes, giving you an hour today will not do it justice in my opinion. There's a litany of ways of coastal management. I mean, I went through it yesterday so fast that she couldn't even record it. I don't think we do it justice.

What I would suggest as a follow-up to this is that maybe a small group decide on addressing your specific issue about all the erosion, proplanning (phonetic) proactive, reactive, and actually set a session. Do something similar to this, maybe a half day. You're going to need engineers, geologists, you're going to need a whole gamut of professionals to propose and discuss those in the appropriate manner and in enough detail for you to understand to a point which one would be selected in which area. Giving even an hour after this, I don't think will

really give it justice. They might walk away with the wrong impression, he's not giving it enough time. I suggest setting up a whole other morning workshop with professionals in the field.

DR. GIESE: That could be done.

MR. WATSON: The titled event almost implied that.

DR. GIESE: Thanks. Thanks very much.

MR. HALL: David Hall, Nantucket. I can't help myself. I really am struggling to try to learn about stuff but also to reinforce some comments I was trying to make yesterday.

There's a perception, it's a very, very strong perception among us, maybe more among the public than us, but among people, that we've got a problem, the sea is rising, beaches are moving, and there is surely the technology out there somewhere that if we can just find it, develop it, and then select the right one, we can fix this problem.

I would like to just juxtapose that concept, which is a very human need to deal with these very serious problems we're dealing with to fix that. To juxtapose that concept of being able to fix it with the latter part of this -- the last breakout session, which dealt with issues of sustainability. Now, sustainability is a highly -- it's like when we were dealing with yesterday's discussion of inner shores, and we finally fit how all these different characteristics fit into the matrix, and the bottom line there was for most of them, they all sort of were components of erosion.

Well, I would suggest that sustainability is the bottom line for so many realms of human history and human social intercourse- economic, cultural, et cetera. It's a highly, highly charged question, and deserves a great deal of discussion because that's the bottom line as far as whether we're going to be around here in 1,000 years or not. But I'd still like to say the sustainability -- issues of sustainability are highly, highly complex. And the bottom line, as far as I understand it, is that we don't know a great deal about sustainability except to define it in part as the natural system, the natural, unaltered system. Those of us who are lucky enough to be working in environments that are largely unaltered, our management strategy is to maintain them as much as possible as unaltered areas. The second, the moment, the minute we begin saying, well, let's tweak it, let's improve it, let's restore it, I think we enter into a very, very dangerous ground because we don't know always that what we're trying to do and setting out to do is what we're going to end up with. And I think that the discussion earlier on Long Island is a great case in point. The best engineers, the best scientist back in, I don't know, when those groins were first put in, determined that this was the way we should go, and now, to the tune of, what is it, $500 million or better, we're still working on trying to fix that initial problem.

Back to the issue of this last exercise, Graham, if I were to try to track on Nantucket how well we're doing and what we're doing, I would say, okay, within the regulatory framework, how many acres do we have on the islands that are relevant to coastal processes? What's the total acreage? How many of those total acres have been altered in the past? Every year, how many additional acres do we allow to be altered? To me, that's a very, very critical bottom line.

Given these miles and miles of shoreline, our job, given issues of sustainability, given the great unknowns, is to at all possible costs minimize future development in those areas.

Where development is critical and is necessary, there are other means by which we can address how well we're doing. What are the buffers to those resource areas, what is the aerial extent of impact within the resource areas, or within their buffers? These are very, very clear calculable -- calculatable calculations based on the plans that we get. If we can simply measure these areas, I think we can come up with some totals of how well we're doing from that regard.

In terms of then making that next leap as to whether this proposed project fits into a sustainable model or not, that's a very, very difficult step to make, and I don't know that at this point I can make that, but I certainly could identify how many acres we are allowing to be altered and to what extent.

DR. GIESE: That's very helpful, and I'm looking forward to your help, David, in the future, as we try our first experiment with these.

Anyone else want to say something? This is the time when you can do it. You really can say what you'd like.

MS. BALOG: I want to go back to the discussion we were just having just a moment ago and talk about the real world that we all live in. I would agree, it would be wonderful if we could prevent impacts, but we also know that people have the right to do certain things with their land under federal laws that we operate under. The first time you're involved in a very serious piece of litigation, I think it has a tendency to bring you up short and realize what the parameters that we all have to work in and realize that there are some constitutional rights regardless of what we may feel. I think that one of the other things that we must recognize is that man has the strong desire to alter the landscape. Nature also can do very catastrophic things to its own landscape. We're only talking about coastal erosion. There are many, many catastrophic events that occur that can expunge every single one of these structures and houses.

I think it's important to recognize the scales with which we're working in. The laws have us looking at individual pieces of property and not the system. We all recognize that the system-wide approach would make a lot more sense. Unfortunately, the current regulatory framework doesn't allow us to address cumulative impacts at this point. I think that might be where -- I would hope that's where the laws and where we try to push the laws to be because that's clear that septic (phonetic) systems that we put by the properties may be, in fact, one of the greater impacting things to our estuaries and our water bodies. We now realize that 200 feet, 1,000 feet, may not be far enough to deal with the nutrient impacts into many of embayments. We're killing them at a very rapid rate. Of course, it all depends on your flushing rate.

But, I think that some of the issues that we're talking about are really scaling factors. I think that maybe one of the problems that we really are struggling on is we're looking at everything on a lot-by-lot basis and not on bigger time scales, and also I just think that sometimes we have a tendency to think that oh, we just killed the golden goose. I think that

sometimes your mistakes can be as instructive as the projects that work well. I don't want you to think that the world is coming to an end because it's not. I have seen examples of things that are done on the Cape that appalled me initially, but I recognize that those ditches that they dug actually linked and enhanced some of the wildlife values, and did things that may have created certain water quality impacts, but ultimately had greater wildlife value. So there are going to always be trade-offs. I think we all need to recognize that, and hope for the best, and try to work towards a more cohesive body of laws that deal with the real issues and not maybe sometimes deal with just these little slices of land that we're forced to look at. And I think that is really where we should be focusing our energy.

DR. GIESE: I think the panel has worked hard. These four have worked maybe a little harder than the rest of us.

I'd like to take a little time. If you have anything that you'd like to say about the meeting. Judy, we'll start at your end.

DR. PEDERSON: Actually, I was just going to comment because in two or three discussions, people talked about the decisions and the projects of this last group, and keep coming back to that although I forced them to make some decisions about how well the towns were doing related to this, it did come back to the point that it was the regulations that may not be looking at sustainable landforms. There are a lot of other factors that come into the regulations, and that, I think, is really the take-home message. And the question is, how important is it to modify the regulations again to deal with some other issue. Where are your priorities?

DR. GIESE: Thank you for that. Yes, any comment that you have. You want to sum anything about your experiences in the workshop or about the bigger view.

DR. LEAVITT: As I've been claiming all along, I'm a biologist and I really have learned a lot in the last two days. I certainly developed an appreciation for the efforts that all of you in the audience go through to try to deal with these issues on a daily basis. All I can say is I'm glad it's you and not me. I guess that's about it. I just want to thank you all for helping me and teaching me as part of this workshop as well.

MR. HENSON: The participation has been fantastic. I was, as we've discussed internally here, a little bit tentative about the role-playing thing that we kicked off with yesterday. I thought it was a good move to not advertise the fact that we were going to do that in advance, but it went exceedingly well for some. I think it was an opportunity for some to vent a little bit, but the level of participation, I think, is what really made this workshop a success.

But I think if nothing else, as was suggested in an earlier comment, if we leave here having simply thought about a more comprehensive list of issues and considerations when we look at these projects, I think we've done an awful lot of good. And I think the exercises yesterday afternoon and late this morning were particularly valuable in that we've, I think,

really increased our ability to look at all the right things when we're evaluating proposals both before and after.

MS. EARLY: I would like to say that I am sad to see the workshop end, because I have enjoyed being a part of my working group today, and the group of workshop organizers.

And, again, it is thanks to Graham for pulling us together to discuss these issues and I have found it tremendously useful for the work I am involved in with the Pleasant Bay Management Plan and with the Cape Cod Commission's Regional Policy Plan where we need to get feedback on some of the coastal development issues, such as rationales for setback requirements, the extent to which a structure should be raised above the base flood level, and on other similar standards.

Thank you all for participating.

DR. GIESE: Well, thank you. I want to thank two people that aren't here, but are really the people who have been responsible for getting this thing started, and that's Tracey Crago and Sheri DeRosa.

(Applause)

Thanks, everybody. It's been a wonderful time being with you. Have a good weekend and let's keep in touch.

COASTAL LANDFORM MANAGEMENT IN MASSACHUSETTS

Reception and Poster Session

Thursday, October 9, 1997

Alongshore Variability in Shoreline and Foredune Mobility
Dr. James Allen, National Park Service

Historic Shoreline Change Mapping and Analysis in Massachusetts
Mr. Jim O'Connell, Massachusetts Coastal Zone Management

Coastal Landform Management: Balancing Development Interests with Environmental Protection on Cape Cod
Ms. Julie Early, Cape Cod Commission

Patterns of Erosion on a Transgressive Coast: Landform Change Determination Using Aerial Photographs and GIS
Ms. Stacy Shafer, Institute for Quaternary Studies, University of Maine, Orono

Marsh Habitat Restoration at Herring River, Cape Cod National Seashore
Dr. John Portnoy, Cape Cod National Seashore

Marsh Habitat Restoration at Hatches Harbor, Cape Cod National Seashore
Dr. John Portnoy, Cape Cod National Seashore

Management of Beach Road, Martha's Vineyard
Ms. Lisa Rhodes, Massachusetts Highway Department, and Dr. Stanley Humphries, ENSR

Morphology, Stratigraphy, and Evolution of Selected Barriers Along the Merrimack Embayment
Dr. Duncan Fitzgerald, Mr. Don Hunt, Mr. Paul McKinlay, and Ms. Ilya Buynevich, Boston University

Historical Analysis of Changes in Nauset Inlet, Outer Cape Cod
David G. Aubrey and William Robertson V, Woods Hole Oceanographic Institution

Glossary

accretion - *1.* The gradual addition of new land to old by the deposition of sediment carried by flowing water. 2. The process by which inorganic bodies grow larger, by the addition of fresh particles to the outside.

barrier beach - Offshore bar. This term refers to a single elongate sand ridge rising slightly above the high-tide level and extending generally parallel with the coast, but separated from it by a lagoon or wetlands. The term should apply to islands and spits.

coastal bank - The rising ground bordering a lake, river, or sea.

coastal plain - Any plain that has its margin on the shore of a large body of water, particularly the sea, and generally represents a strip of recently emerged sea bottom.

drum; drumlins - *1.* Gravel hills that have an elongated form, are generally steepest toward one side, and rise in every other direction by much more gentle acclivities. 2. Till is sometimes accumulated in hills of elliptical base and arched profile, known as drumlins, the longer axis often measuring half a mile or more and standing parallel to the direction in which the ice sheet moved, the height reaching 30.5 to 61 m. *3.* A streamlined hill or ridge of glacial drift with long axis paralleling direction of flow of former glacier.

dune - *1. Geol.:* A low hill, or bank, of drifted sand. 2. Mounds and ridges of wind-blown or eolian sand are dunes. Once started, a dune becomes an obstacle to blowing sand, and the lodgment of more sand causes the dune to grow. In this way, mounds and ridges of sand, scores and sometimes even hundreds of feet high are built by the wind. *3.* A mound, ridge, or hill of wind-blown sand, either bare or covered with vegetation.

esker - Osar, asar; eschar; eskar; serpent kame. *1.* Eskers or kames, unlike the drumlins, are rudely stratified accumulations of gravel, sand, and waterworn stones. They are of rough fluvial or torrential origin, and occur in long tortuous ridges (serpent kames), mounds, and hummocks. They have the general direction of the drainage, though sometimes not according with the present course of drainage. 2. Serpentine ridges of gravel and sand. These are often associated with kames, and are taken to mark channels in the decaying ice sheet, through which streams washed much of the finer drift, leaving the coarser gravel between the ice walls.

flanks - Ends of coastal engineering structures.

flood plain - That portion of a coast or river valley which is built of sediments and which is covered with water during flood conditions.

gabions - Box-shaped containers, often constructed of heavy-wire mesh and containing aggregates of cobbles, used in the construction of revetments (q.v.) and other coastal engineering structures.

high water line - In a strict interpretation the intersection of the plane of mean high tide with the shore. The shoreline delineated on the nautical charts of the U.S. Coast and Geodetic Survey is an approximation of the high tide line.

interlobate - Situated between lobes. *Geol:* Lying between adjacent glacial lobes, as deposits.

kame - *1.* A conical hill or short irregular ridge of gravel or sand deposited in contact with glacier ice. 2. Kames is a Scotch term applied to assemblages of short, conical, often steep hills, built of stratified materials and inter-locking and blending in the most diversified manner. *3.* A mound composed chiefly of gravel or sand, whose form is the result of original deposition modified by settling during the melting of glacier ice against or upon which the sediment accumulated. *4.* A hill of stratified drift deposited, usually as a steep alluvial fan, against the

edge of an ice sheet by debouching streams of sediment-laden meltwater. 5. A low, steep-sided hill of stratified drift, formed in contact with glacier ice.

littoral - 1. Belonging to, inhabiting, or taking place on or near the shore. 2. The benthonic environment between the limits of high and low tides.

moraine - 1. Drift, deposited chiefly by direct glacial action, and having constructional topography independent of control by the surface on which the drift lies. 2. An accumulation of drift having initial constructional topography, built within a glaciated region chiefly by the direct action of glacier ice. The term has been used in many different ways and its history is confused.

outwash - Drift deposited by meltwater streams beyond active glacier ice.

outwash plain - A plain composed of material washed out from the ice.

overwash - The process in which shoreward flowing water, impelled by breaking waves, surges up and over coastal berms, barrier beaches, dunes, etc.

revetments - Coastal engineering structures designed to prevent or reduce shore erosion. Revetments are usually placed parallel to the shoreline between the beach and the shoreside development (houses, roads, etc.) that they are designed to protect. Unlike the similar "sea walls," revetments have a sloping seaward face and consist of aggregates, both of which are intended to reduce reflected wave energy.

scarp - An escarpment, cliff, or steep slope of some extent a beach or coastal bank.

scour - Erosion, especially by moving water, impelled by wave action.

spit - A small point of land or narrow shoal projecting into a body of water from the shore.

velocity zone - A coastal high-hazard zone designated by the National Flood Insurance Program to restrict development in areas most likely to be impacted during severe coastal storms.

Wisconsin glaciation - The last of four classical glacial stages in the Pleistocene of North America.

COASTAL LANDFORM MANAGEMENT IN MASSACHUSETTS

Workshop Participants

Frank Ackerman
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

James Allen
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Carolyn Baker
Falmouth Conservation Comm.
59 Town Hall Square
Falmouth, MA 02540

Walter Bakowski
The BSC Group, Inc.
425 Summer Street
Boston, MA 02210

Tina D. Balog
Brewster Conservation Comm.
Town Offices, 2198 Main St.
Brewster, MA 02631

Vicky Bebout
Cape Cod Commission
P.O. Box 226
Barnstable, MA 02630

Peg Brady
Mass. Coastal Zone Management
100 Cambridge Street
Boston, MA 02202

Bill Burke
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Armando Carbonell
Cape Cod Commission
P.O. Box 226
Barnstable, MA 02630

William Clark
Mass. Bays Program/MAPC
60 Temple Place
Boston, MA 02111

Tracey Crago
WHOI Sea Grant Program
193 Oyster Pond Rd., MS #2
Woods Hole, MA 02543-1525

Cheryl Creighton
Nantucket Land Council
P.O. Box 502
Nantucket, MA 02554

James DeCoulos
DeCoulos & Co.
248 Andover Street
Peabody, MA 01960

Sheri DeRosa
WHOI Sea Grant Program
193 Oyster Pond Rd., MS #2
Woods Hole, MA 02543-1525

Ed DeWitt
157 Locust Street
Falmouth, MA 02540

Elizabeth Dolan
Oak Bluffs Conservation Comm.
P.O. Box 1327
Oak Bluffs, MA 02557

Anne Donovan
Mass. Coastal Zone Mgmt.
100 Cambridge Street
Boston, MA 02202

Julie Early*
Cape Cod Commission
P.O. Box 226
Barnstable, MA 02630
**currently with the Island Foundation*

Reena Epstein
Bourne Conservation Comm.
Town Hall, 24 Perry Avenue
Buzzards Bay, MA 02532

Ann Federico
Office of Cong. William Delahunt
146 Main Street
Hyannis, MA 02601

Walter Fender
Dept. of Public Works, Marshfield
Box 488
Brant Rock, MA 02020

Fred Fenlon
Eastham Conservation Comm.
555 Old Orchard Road
Eastham, MA 02642

Donald Fleming
P.O. Box 396
Mattapoisett, MA 02739

Frank Gable
24 Rockland Street
Natick, MA 01760

Mark Galkowski
Sandwich Conservation Dept.
16 Jan Sebastian Drive
Sandwich, MA 02563

Robert Gatewood
Barnstable Conservation Comm.
367 Main Street
Hyannis, MA 02601

Maggie Geist
Waquoit Bay National Estuarine
Research Reserve (WBNERR)
P.O. Box 3092
Waquoit, MA 02536

Graham Giese
WHOI Sea Grant Program
193 Oyster Pond Rd., MS #2
Woods Hole, MA 02543-1525

Joseph Grady
Duxbury Conservation Comm.
878 Tremont Street
Duxbury, MA 02332

Erin Haight
Mass. Highway Dept.,/Wetlands
10 Park Plaza
Boston, MA 02116

Sue Haley
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

H. David Hall
Nantucket Conservation Comm.
37 Washington Street
Nantucket, MA 02554

Rebecca Haney
Mass. Coastal Zone Management
2 Spring Street, 2nd Floor
Marion, MA 02378

Jane Harris
Mass. Assoc. of Commissions
119 Arbutus Trail
Chatham, MA 02633

Norman W. Hayes
The BSC Group, Inc.
425 Summer Street
Boston, MA 02210

Truman Henson
Mass. Coastal Zone Management
P.O. Box 220
Barnstable, MA 02630-0220

Diane Holdgate
Nantucket Conservation Comm.
37 Washington Street
Nantucket, MA 02554

William Hughes
Jennian Enterprises
6 Eastman Place
Melrose, MA 02176

Stan Humphries
ENSR
95 State Road
Buzzards Bay, MA 02532-2415

Don Hunt
Lab. of Duncan Fitzgerald
Boston University
Boston, MA 02215

David Lajoie
Felco, Inc.
P.O. Box 1366
Orleans, MA 02653

Dale Leavitt
WHOI Sea Grant Program
193 Oyster Pond Rd., MS #2
Woods Hole, MA 02543-1525

COASTAL LANDFORM MANAGEMENT IN MASSACHUSETTS

Workshop Participants

Henry Lind
Eastham Conservation Comm.
555 Old Orchard Road
Eastham, MA 02642

Melissa Lowe
Massachusetts Audubon Society,
Wellfleet Bay
P.O. Box 236
South Wellfleet, MA 02663

Daniel Lynch
D.J. Lynch Engineers
Box 1303
Marblehead, MA 01945

David Lyttle
Ryder & Wilcox
P.O. Box 439
S. Orleans, MA 02662

Sandy Macfarlane
Orleans Conservation Comm.
Town Hall, 19 School Road
Orleans, MA 02653

James Mahala
Dept. of Environmental Protection
20 Riverside Drive
Lakeville, MA 02347

Brian Malone
Dennis Natural Resources Dept.
P.O. Box D
South Dennis, MA 02660

Pamela Mamacos
D.J. Lynch Engineers
Box 1303
Marblehead, MA 01945

Allan C. Mayberry Greenberg
Scituate Conservation Comm.
Chief Justice Cushing Highway
Scituate, MA 02066

Judith McDowell
WHOI Sea Grant Program
193 Oyster Pond Rd., MS #2
Woods Hole, MA 02543-1525

Heather McElroy
Cape Cod Commission
P.O. Box 226
Barnstable, MA 02630

Laura Mello
Mass. Highway Dept.,/Wetlands
10 Park Plaza
Boston, MA 02116

Christine Miller
Friends of Sengekontacket Pond
Box 740
Edgartown, MA 02539

Donald W. Moncevicz
Civil Engineer
40 Pond Street
West Dennis, MA 02670

Coreen Moore
Boure Planning Department
Town Hall, 24 Perry Avenue
Buzzards Bay, MA 02532

Richard A. Musiol, Jr.
Office of Senator Therese Murray
225 S. Water Street
Plymouth, MA 02360

James O'Connell**
Mass. Coastal Zone Management
100 Cambridge Street
Boston, MA 02202
***currently with the Cape Cod Commission*

Judy Pederson
MIT Sea Grant College Program
E38-300 Kendall Sq., 292 Main St.
Cambridge, MA 02139

Michael Pessolano
Harwich Planning Department
732 Main Street
Harwich, MA 02645

Joan Platt
1060 Browns Neck Road
Wellfleet, MA 02667

John Portnoy
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Michael Reynolds
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Lisa Rhodes
Mass. Highway Dept.,/Wetlands
10 Park Plaza
Boston, MA 02116

William Robertson
Dept. of Geology & Geophysics
Woods Hole Oceanographic Inst.
Woods Hole, MA 02543

Chris Ross
Dept. of Environmental Protection
20 Riverside Drive
Lakeville, MA 02347

Charles Sanders
Friends of Sengekontacket Pond
Box 467
Oak Bluffs, MA 02557

Ms. Freddie Seymour
Freddie Seymour Productions
P.O. Box 1369
Sandwich, MA 02563

Kathy Sferra
Marshfield Planning Board
Marshfield, MA 02050

Stacy Shafer
Inst. For Quaternary Studies
University of Maine
Orono, ME 04473

Robert Sherman
Mashpee Conservation Dept.
P.O. Box 208
Mashpee, MA 02649

Lester Smith
Epsilon & Associates
P.O. Box 700
Maynard, MA 01754-0700

William Stevens
Oak Bluffs Conservation Comm.
P.O. Box 1327
Oak Bluffs, MA 02557

Paul Strauss
Oak Bluffs Conservation Comm.
P.O. Box 1327
Oak Bluffs, MA 02557

Edward S. Syrjala
P.O. Box 149
Centerville, MA 02632

Joseph Tamsky
Cape Cod Commission
P.O. Box 226
Barnstable, MA 02630

Jay Tanski
New York Sea Grant
SUNY at Stony Brook
146 Suffolk Hall
Stony Brook, NY 11794-5002

Jo-Anne Taylor
Martha's Vineyard Commission
P.O. Box 1447
Oak Bluffs, MA 02557

Steve Tucker
Chief Ranger, Sandy Neck
141 Bassett Lane
Hyannis, MA 02601

Charles Van Dusen
Applied Geographics, Inc.
100 Franklin Street
Boston, MA 02110

Russell Walton
Chilmark Planning Board
P.O. Box 119
Chilmark, MA 02535-0119

James Watson
Old Colony Planning Council
70 School Street
Brockton, MA 02401

Stephanie Watson
Florida Coastal Mgmt. Program
1408 N. Bronough Street
Tallahassee, FL 32303

Workshop Participants

Peter Wells
Marshfield Planning Board
Marshfield, MA 02050

Arlene Wilson
A.M. Wilson Associates
P.O. Box 486
Barnstable, MA 02630

Patrick Young
Massachusetts Emergency
Management Agency (MEMA)
400 Worcester Road
Framingham, MA 01701-1317

DOCUMENT LIBRARY

Distribution List for Technical Report Exchange – July 1998

University of California, San Diego
SIO Library 0175C
9500 Gilman Drive
La Jolla, CA 92093-0175

Hancock Library of Biology & Oceanography
Alan Hancock Laboratory
University of Southern California
University Park
Los Angeles, CA 90089-0371

Gifts & Exchanges
Library
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, NS, B2Y 4A2, CANADA

NOAA/EDIS Miami Library Center
4301 Rickenbacker Causeway
Miami, FL 33149

Research Library
U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Marine Resources Information Center
Building E38-320
MIT
Cambridge, MA 02139

Library
Lamont-Doherty Geological Observatory
Columbia University
Palisades, NY 10964

Library
Serials Department
Oregon State University
Corvallis, OR 97331

Pell Marine Science Library
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882

Working Collection
Texas A&M University
Dept. of Oceanography
College Station, TX 77843

Fisheries-Oceanography Library
151 Oceanography Teaching Bldg.
University of Washington
Seattle, WA 98195

Library
R.S.M.A.S.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149

Maury Oceanographic Library
Naval Oceanographic Office
Building 1003 South
1002 Balch Blvd.
Stennis Space Center, MS, 39522-5001

Library
Institute of Ocean Sciences
P.O. Box 6000
Sidney, B.C. V8L 4B2
CANADA

National Oceanographic Library
Southampton Oceanography Centre
European Way
Southampton SO14 3ZH
UK

The Librarian
CSIRO Marine Laboratories
G.P.O. Box 1538
Hobart, Tasmania
AUSTRALIA 7001

Library
Proudman Oceanographic Laboratory
Bidston Observatory
Birkenhead
Merseyside L43 7 RA
UNITED KINGDOM

IFREMER
Centre de Brest
Service Documentation - Publications
BP 70 29280 PLOUZANE
FRANCE

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. WHOI-98-16	2. WHOI-W-97-001	3. Recipient's Accession No.

4. Title and Subtitle
Coastal Landform Management in Massachusetts: Proceedings of a Workshop held at the Woods Hole Oceanographic Institution, Woods Hole, MA USA October 9-10, 1997

5. Report Date
October 9-10, 1997

6.

7. Author(s) Tracey I. Crago and Sheri D. DeRosa

8. Performing Organization Rept. No.
WHOI-98-16

9. Performing Organization Name and Address

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C) N/A
(G)

12. Sponsoring Organization Name and Address
Woods Hole Oceanographic Institution Sea Grant Program

13. Type of Report & Period Covered
Technical Report

14.

15. Supplementary Notes
This report should be cited as: Woods Hole Oceanog. Inst. Tech. Rept., WHOI-98-16 or WHOI Sea Grant Report WHOI-W-97-001.

16. Abstract (Limit: 200 words)
The primary objective of this publication is to share with a wider audience the information and ideas that were shared by those attending the first workshop on Coastal Landform Management in Massachusetts that was held at the Woods Hole Oceanographic Institution on October 9 and 10, 1997. The workshop was designed to benefit resource management decision-makers through interactive exercises and discussions of coastal problems ranging from those that arise everyday to those of unusual complexity. The immediate objective of the workshop was to improve familiarity with existing management methodologies. The long-term objective was to improve the methodologies themselves.
The workshop was divided into four sessions, each beginning with a presentation followed by discussion. The discussions took place in four separate "breakout groups"—each led by a facilitator—that looked critically at the presentation and prepared a response. The entire group then reconvened for a panel discussion led by the facilitators and the presenter.
The first presentation (J. O'Connell) discussed the diverse landforms of the Massachusetts coast, the processes that produce and maintain them, and the problems associated with selecting the most appropriate management techniques. The second (S. Macfarlane) focused on difficulties of managing inner shores using the Nauset and Pleasant Bay estuaries as examples. The third (J. Tanski) discussed management of altered shores using as an example Westhampton Beach on the south shore of Long Island. The final presentation (M. Reynolds and G. Giese) concerned the monitoring of changes in coastal landform sustainability and described checklists prepared to help managers monitor such changes.

17. Document Analysis a. Descriptors
Shoreline Change
Coastal Management
Coastal Hazards

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Approved for public release; distribution unlimited.	UNCLASSIFIED	119
	20. Security Class (This Page)	22. Price